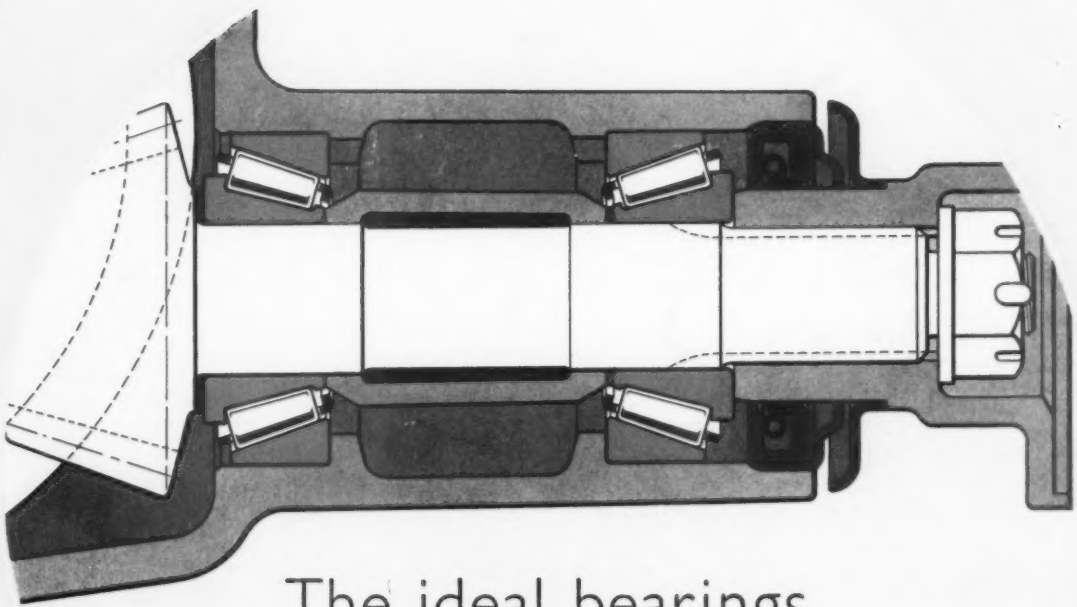
AUTOMOBILE ENGINEER

DESIGN · PRODUCTION · MATERIALS

Vol. 49 No. 13 DECEMBER 1959 PRICE: 3s. 6d.



The ideal bearings
for final drives

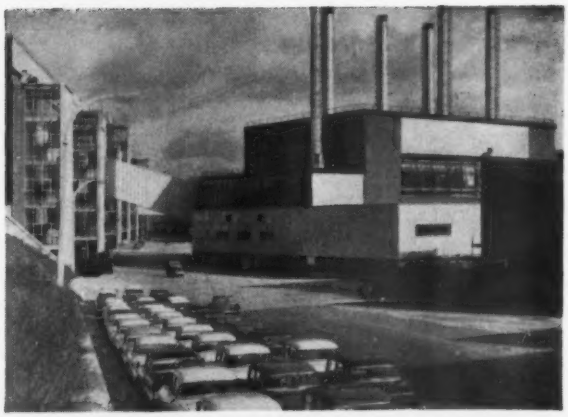
British Timken, Duston, Northampton,
Division of the Timken Roller Bearing Company.
Timken bearings manufactured in England,
Australia, Canada, France and U.S.A.

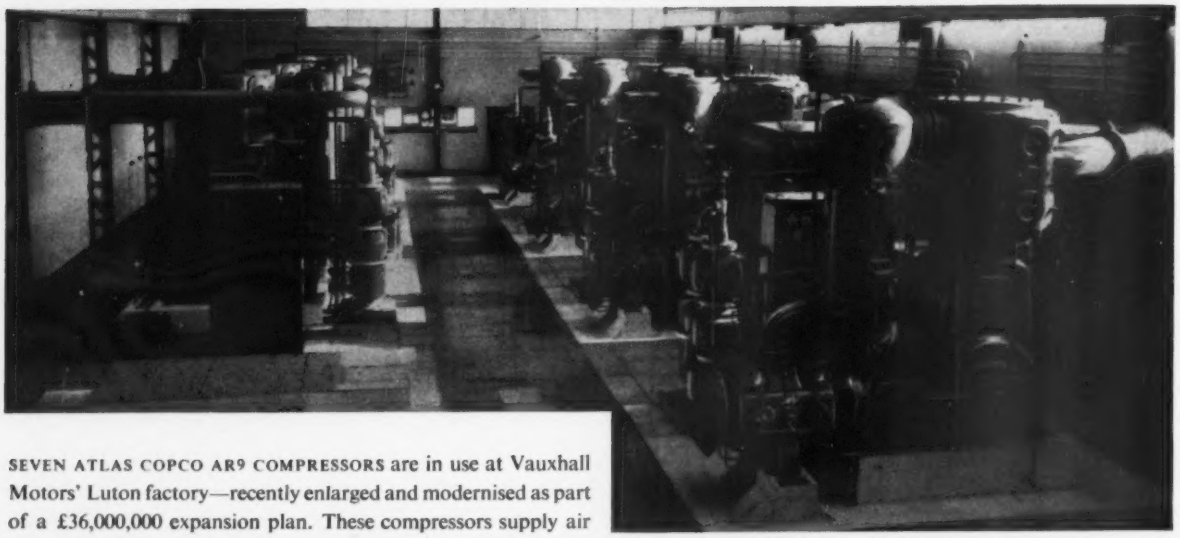
TIMKEN®

REGISTERED TRADE-MARK

tapered roller bearings

Compressed Air at work in Vauxhall's Luton extension





SEVEN ATLAS COPCO AR9 COMPRESSORS are in use at Vauxhall Motors' Luton factory—recently enlarged and modernised as part of a £36,000,000 expansion plan. These compressors supply air to the body fabrication shops, press shops and other departments, providing power for clutch movements; resetting presses; mechanical handling; loading; welding; and mixing and spraying paint. In addition air is supplied for a number of pneumatic tools such as wrenches, grinders, drills and hoists.

ECONOMIC INSTALLATION

The AR9 compressors were installed at a cost below that estimated for other compressors of the same capacity. The reason being that the AR9 occupies 25% less floor space than is normally required —with consequent economies in compressor house costs.

HIGH OUTPUT

The Atlas Copco AR9 combines thorough reliability of performance with unusually high output per horsepower consumed. The installation at Vauxhall's has a total output of 22,540 c.f.m.

A COMPLETE RANGE OF COMPRESSED AIR EQUIPMENT

Atlas Copco manufactures portable and stationary compressors, rock-drilling equipment, loaders, pneumatic tools and paint-spraying equipment. Sold and serviced by companies or agents in ninety countries throughout the world.

Atlas Copco PUTS COMPRESSED AIR TO WORK FOR THE WORLD

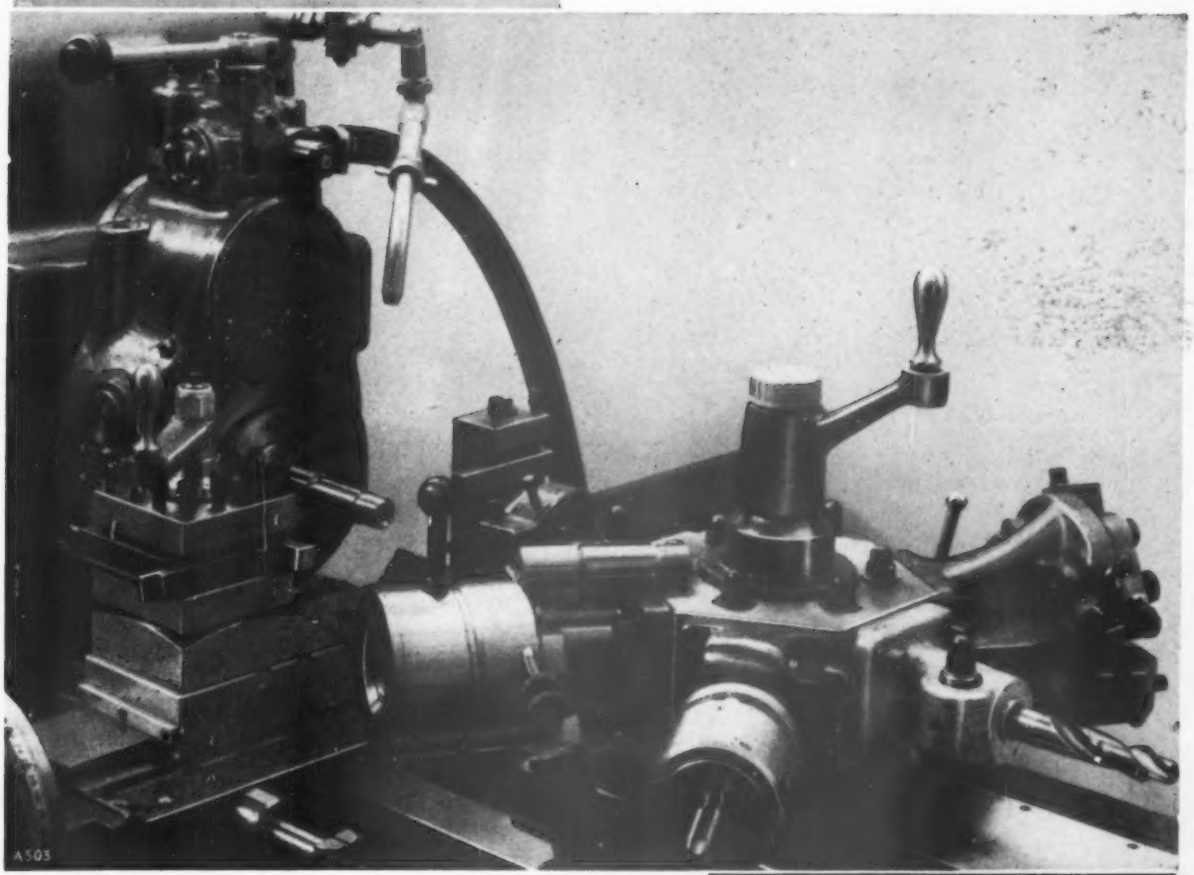
Contact your local company or agent or write to Atlas Copco AB, Stockholm 1, Sweden or Atlas Copco, (Great Britain) Limited, Maylands Avenue, Hemel Hempstead, Herts.

C.16

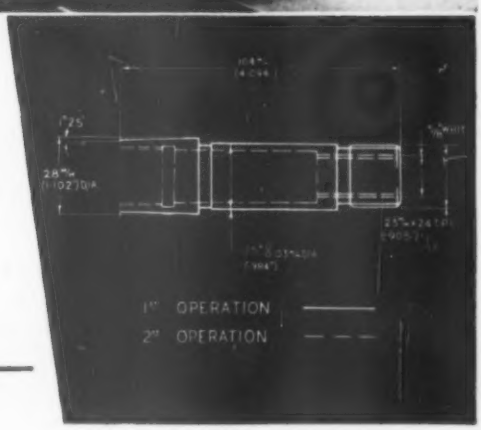
HERBERT

No. 2D Capstan Lathe, the ideal machine for bar work up to 1½" diameter and chuck work up to 9" swing.

Now available for **Early Delivery**



The component shown is machined from 35 tons tensile steel bar on a Herbert 2D Capstan Lathe: The illustration shows the tooling arrangement for the first operation which is completed in a time of 5 mins.

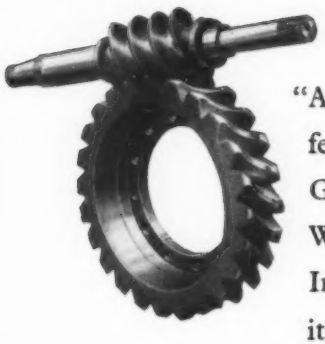


ALFRED HERBERT LTD., COVENTRY

AD.455

Who's behind

the man behind the wheel?



"A vehicle is only as good as its transmission." Some people might feel disposed to argue about this—but not anyone at the Automobile Gearbox Division of David Brown. We believe it. We live by it. We make it the basis of our business.

In the days when the internal combustion engine was fighting it out with the horse, David Brown were making gears and gearboxes. We are still making them—'standards' and 'specials'; by which we mean 'standards' that are special and 'specials' that are extra special. And we make them in a wider variety than you will find anywhere else in the country.

And so, when the man behind the wheel has behind *him* the name of David Brown, he can have confidence in the transmission. Every confidence. And this applies whether the vehicle in question is a lorry, a van, a bus, a tractor or a forklift truck.

MODEL 557/480
5 speed. Forward control. Constant mesh on all speeds. Maximum engine torque 480 lb./ft. Approximate weight 470 lb.

DAVID BROWN

THE DAVID BROWN CORPORATION (SALES) LIMITED

AUTOMOBILE GEARBOX AND GEAR DIVISIONS, PARK WORKS, HUDDERSFIELD. TEL. HUDDERSFIELD 3500

OA/8701

AUTOMOBILE PARTS

APN

We are specialists in the manufacture of precision and standard fasteners for the Motor Industry

NEWALLOY - Wheel Bolts, Wheel Studs.

NEWALLASTIC - Cylinder Head Studs and Bolts, Connecting Rod Bolts, etc.

NEWALLEX - Induction hardened Spring Shackle Pins and Bolts.

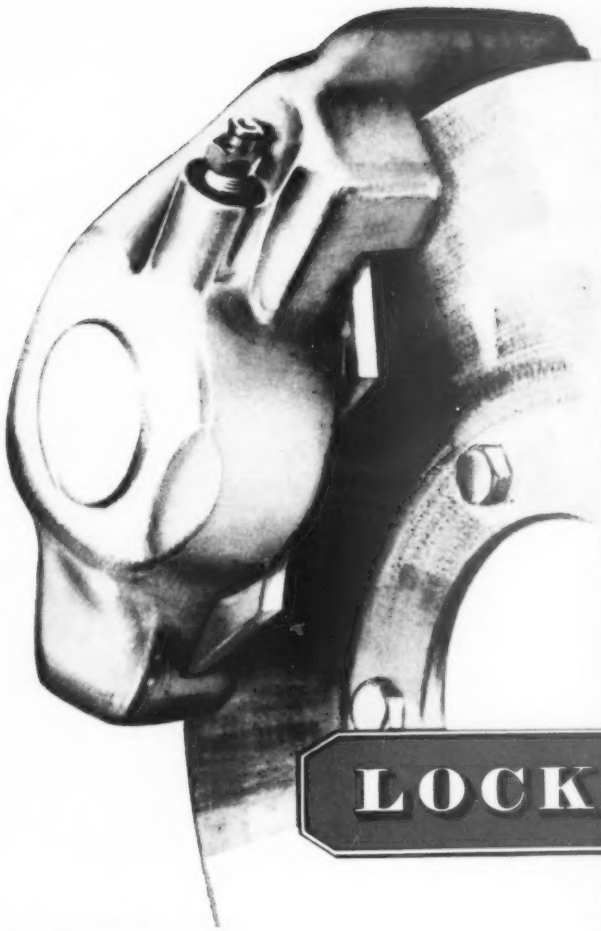
Standard bolts and nuts supplied in "R", "T", and "V" quality, and other Alloy Steels.

Group of typical components, as supplied to the leading motor car manufacturers.

A.P.Newall

AND COMPANY LIMITED

POSSILPARK • GLASGOW N.2.



DRUM

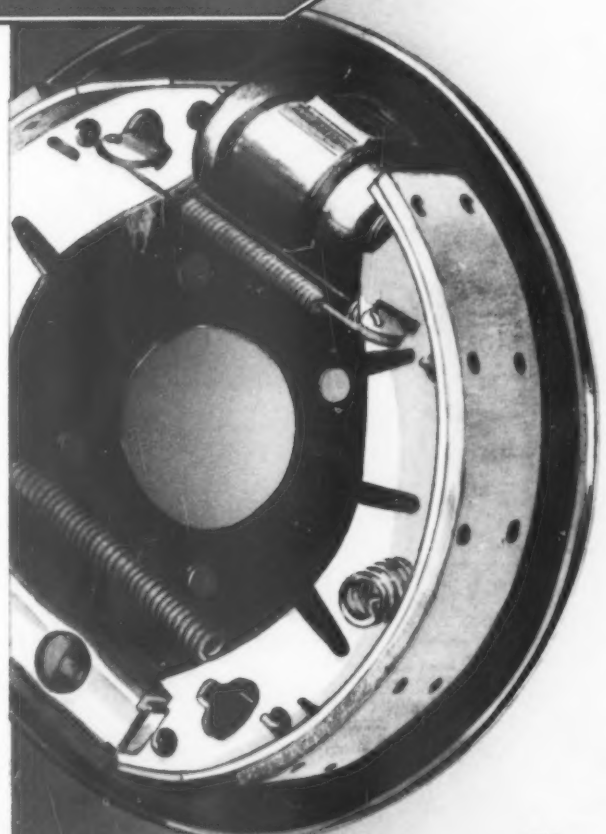
brakes,
developed to the
highest pitch—
suitable for use
with I.R.S.
Improved adjusters

LOCKHEED

REGISTERED
TRADE
MARK

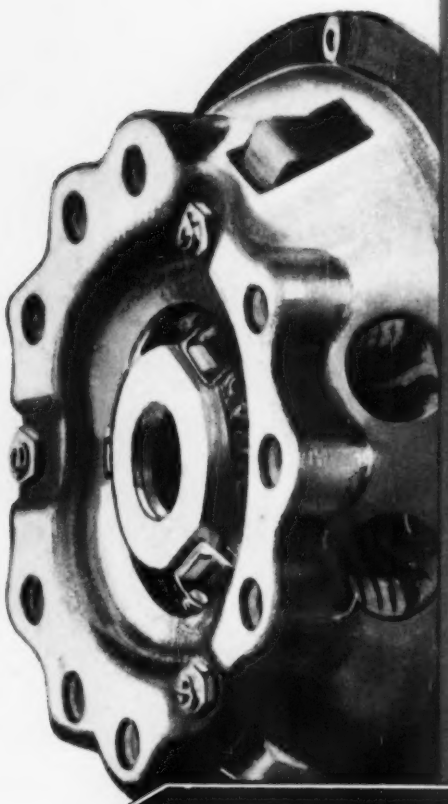
DISC

brakes, praised
by all who have used them
—fitted by Britain's
biggest car producers.
Vacuum booster and
limiting valve available



LOCKHEED HYDRAULIC BRAKE
COMPANY LIMITED
LEAMINGTON SPA, WARWICKSHIRE, ENGLAND

ONE OF THE AUTOMOTIVE PRODUCTS GROUP

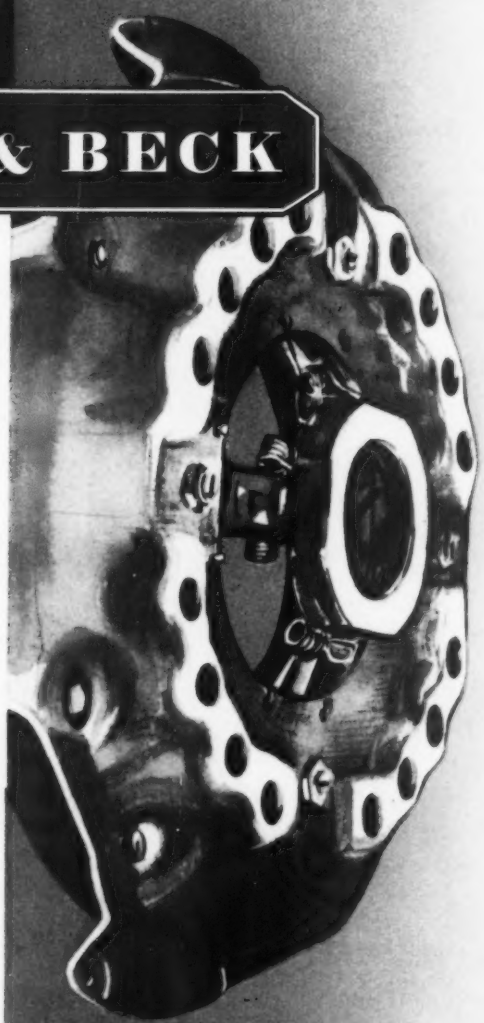


STRAP-

drive clutches,
self-centring,
free from
metal-to-metal
sliding, in
additional sizes

BORG & BECK

Regd. Trade Mark



CLUTCHES

in the widest
range produced
and brought to the
highest pitch of
reliable perfection

BORG & BECK COMPANY
LIMITED
LEAMINGTON SPA, WARWICKSHIRE, ENGLAND

ONE OF THE AUTOMOTIVE PRODUCTS GROUP

AIR

filters, with the 'Micronic' element; low flow losses— effective filtration, dry-type and easy to clean

PUROLATOR

OIL

full flow filters with the famous 'Micronic' plastic impregnated paper element. Also for diesel fuel

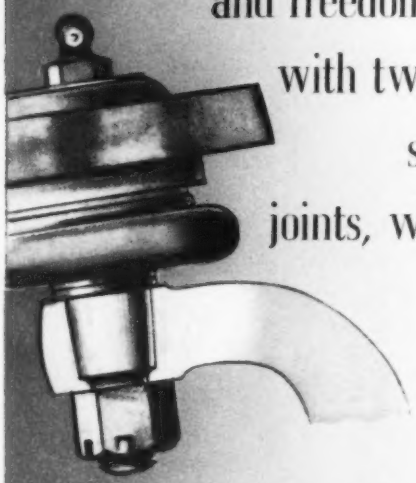
AUTOMOTIVE PRODUCTS COMPANY LIMITED

LEAMINGTON SPA, WARWICKSHIRE, ENGLAND

ONE OF THE AUTOMOTIVE PRODUCTS GROUP

STEERING

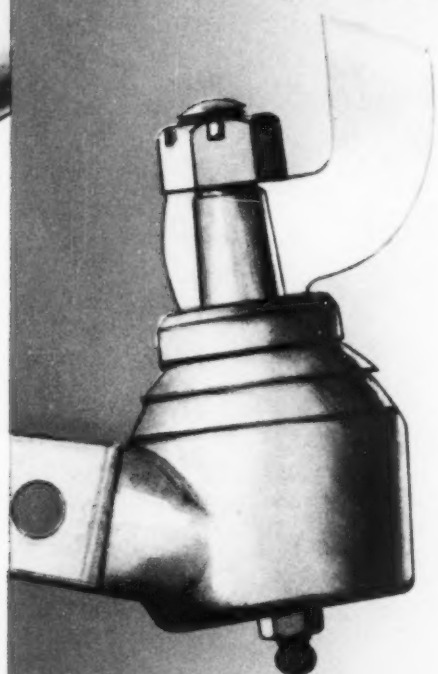
connections :
self-adjusting
of fine material
and workmanship
giving
excellent performance
with durability



For the greatest simplicity
and freedom in steering,
with two Thompson
self-adjusting
joints, which provide
for steering
swivelling
plus
I.F.S. articulation.
The ideal

THOMPSON

SUSPENSION



AUTOMOTIVE PRODUCTS COMPANY
LIMITED
LEAMINGTON SPA. WARWICKSHIRE. ENGLAND

ONE OF THE AUTOMOTIVE PRODUCTS GROUP

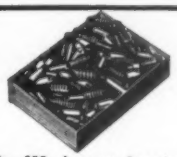
Could this be the spring you're looking for?

Then you'll find it down below

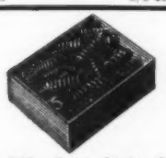
Whatever you need in the way of springs you'll find in the range of TERRY'S BOXES OF ASSORTED SPRINGS—compression, expansion, long, short, light, heavy—the lot.

Just the job for you experimental people—a simply unlimited assortment from our tremendous range of springs of every variety. The boxes shown here are only a few examples—why not let us send you our illustrated list showing them *all?*

No. 760. 3 doz. Assorted Light Compression Springs. 1" to 4" long, 22 to 18 S.W.G., ¼" to ½" diam. 6/6 each.



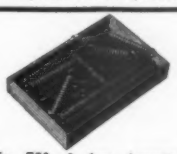
No. 388. ½ gross Assorted Small Expansion Springs. ¾" to 1¼" long, ¼" to ½" diam., 18G to 21G. 9/6 each.



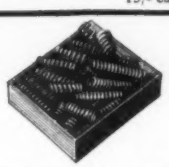
No. 757. Extra Light Compression, 1 gross Assorted ⅛" to ⅜" diam., ½" to 2½" long, 27 to 19 S.W.G. 15/- each.

No. 466. ½ gross Assorted Small Expansion Springs ¾" to 1¼" long, 3/32" to 3/16" diam., 21G to 24G. 6/6 each.

No. 758. Fine Expansion Springs. 1 gross Assorted ¼" to ⅝" diam., ½" to 2" long, 27 to 20 S.W.G. 15/- each.

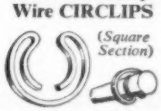


No. 753. 3 doz. Assorted Light Expansion ½" to ¾" diam., 2" to 6" long, 22 to 18 S.W.G. 10/6 each.



No. 98A. 3 doz. Assorted 1" to 4" long, ½" to ⅝" diam., 19G to 15G. 5/6 each.

Cut production costs with Terry Wire CIRCLIPS



We can supply from stock in sizes from ⅛" to ⅝".

No. 1024. 20 Compression Springs 12" long. ¼" to ½" diam., 24G to 18G, suitable for cutting into shorter lengths; and 30 Expansion 1½" to 12" long. 5/32" to ⅝" diam., 22G to 16G. 24/- each.

★ Interested in Springs? Ninth Edition of "Spring Design & Calculations"—post free 12/6.

TERRY'S

ASSORTED SPRINGS

Herbert Terry & Sons Ltd, Redditch, Worcs.

(Makers of Quality Springs, Wireforms and Presswork for over 100 years)

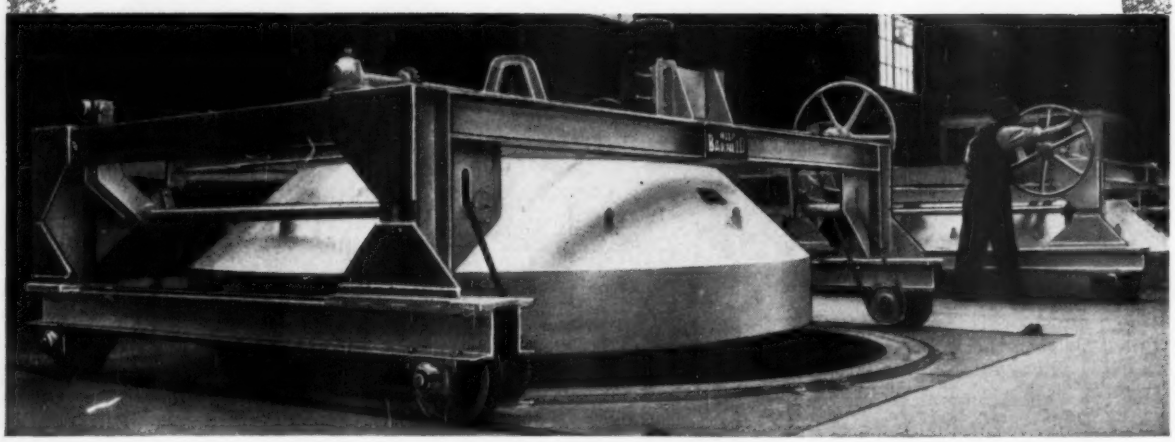
*** Have you a Presswork problem?**

If so let us have it and we'll help to solve it for you.

HT 26

There's over forty years experience behind each WILD BARFIELD furnace

Forty years' specialised experience in furnace manufacture has enabled Wild-Barfield to develop a range of standard equipment embodying dimensions and characteristics to meet the needs of modern industry.
Whether for toolroom, production heat-treatment work or for specialised applications, Wild-Barfield standard equipment provides worthwhile economies.



There are standard ELECTRIC WILD BARFIELD FURNACES for all heat-treatment purposes

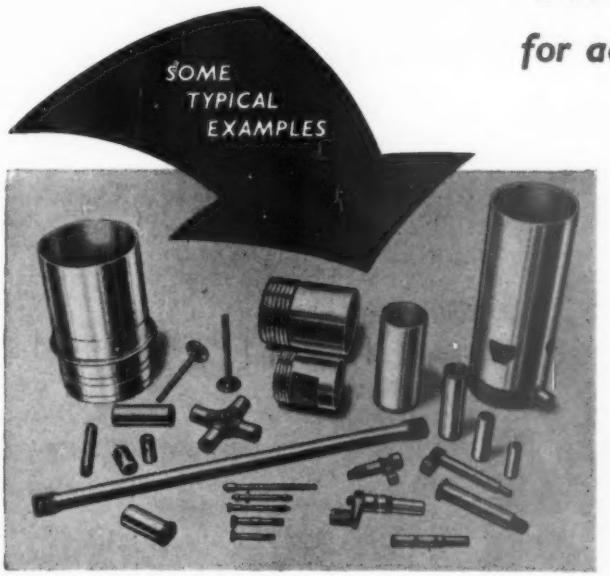
WILD-BARFIELD ELECTRIC FURNACES LIMITED
ELECFURN WORKS, OTTERSPOOL WAY, WATFORD BY-PASS, WATFORD, HERTS. *Telephone: Watford 26091 (8 lines)*

WB94

LIDKOPING

CENTRELESS GRINDING MACHINES

for accurate, high-output production



The type 4B machine illustrated is widely employed for production of automobile components and is also a popular machine for the electrical and textile industries, in fact, wherever high output, close tolerance centreless grinding is required.

The grinding and regulating spindles are supported at both ends in super-precision roller bearings of equal resistance and the grinding wheel spindle drive is through a torsion bar to relieve the spindle of belt tension. The range of work diameters which can be ground on the 4B machine is 0.04 in.—6 in. and maximum length for infeed work is 11.8 in.

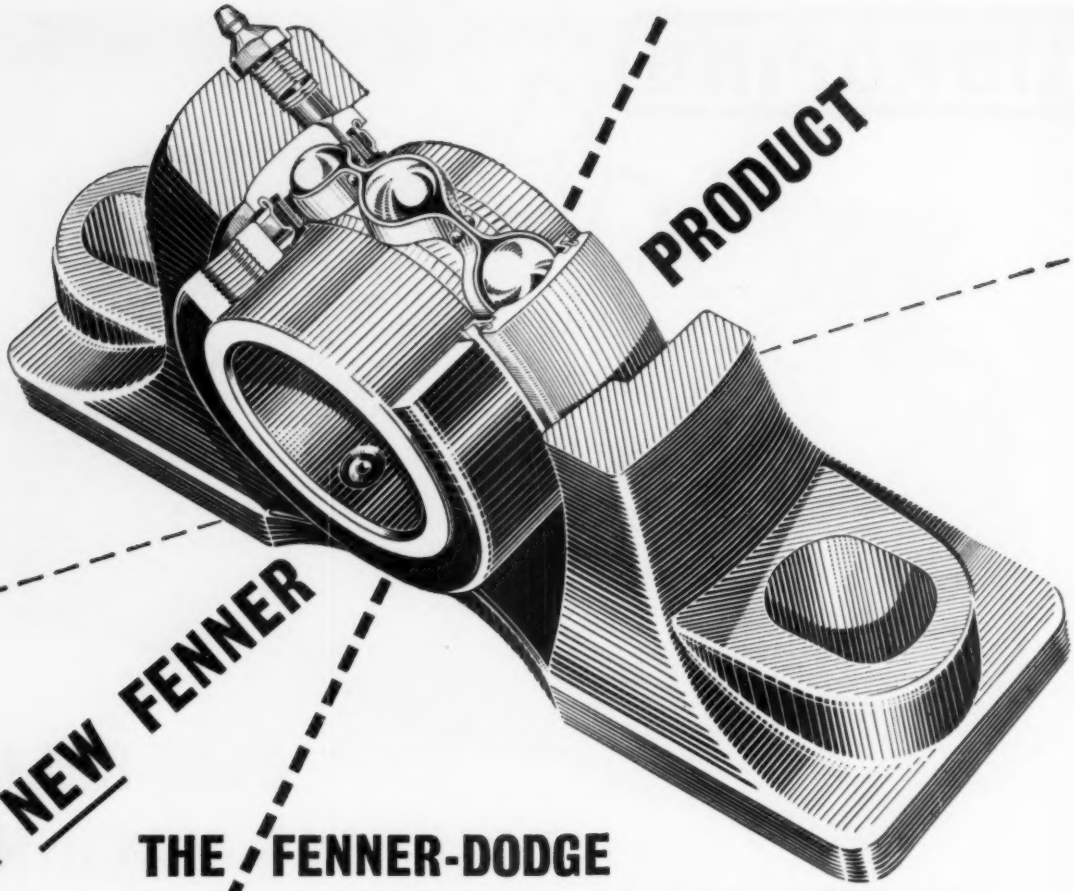
Write to-day for full details of the Lidkoping range of centreless grinding machines.

Sales and Service for the British Isles

DRUMMOND-ASQUITH LIMITED

KING EDWARD HOUSE, NEW ST., BIRMINGHAM *Phone: Midland 3431. Also at LONDON Phone: Trafalgar 7224 & GLASGOW Phone: Central 0922*

IF 322



A NEW FENNER PRODUCT

THE FENNER-DODGE SC BALL BEARING PLUMMER BLOCK

with these special 5 star features :-

★ A sealed bearing with relubrication facilities giving longer life under arduous conditions.

★ Easy to fit housing designed to give adequate spanner room and elongated bolt holes allow lateral adjustment.

★ Separate collar provides bearing to shaft fixing without distortion of inner race.

★ Special seal designed for low frictional losses and keeps grease in and dirt out.

★ Deep groove ball bearing with long inner race distributes loads over greater shaft area, and is fully self aligning.

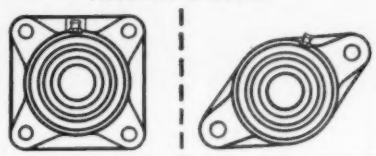
Send for leaflet 250/19

Fenner

J. H. FENNER & CO. LTD., MARFLEET, HULL

BRANCHES AT: *BELFAST, BIRMINGHAM, BRADFORD, BRISTOL, BURNLEY, CARDIFF, GLASGOW, HULL, LEEDS, LEICESTER, LIVERPOOL, LONDON, LUTON, MIDDLESBROUGH, MANCHESTER, NEWCASTLE-ON-TYNE, NOTTINGHAM, SHEFFIELD, STOKE-ON-TRENT.*

ALSO AVAILABLE IN



4 BOLT FLANGE BEARING | 2 BOLT FLANGE BEARING

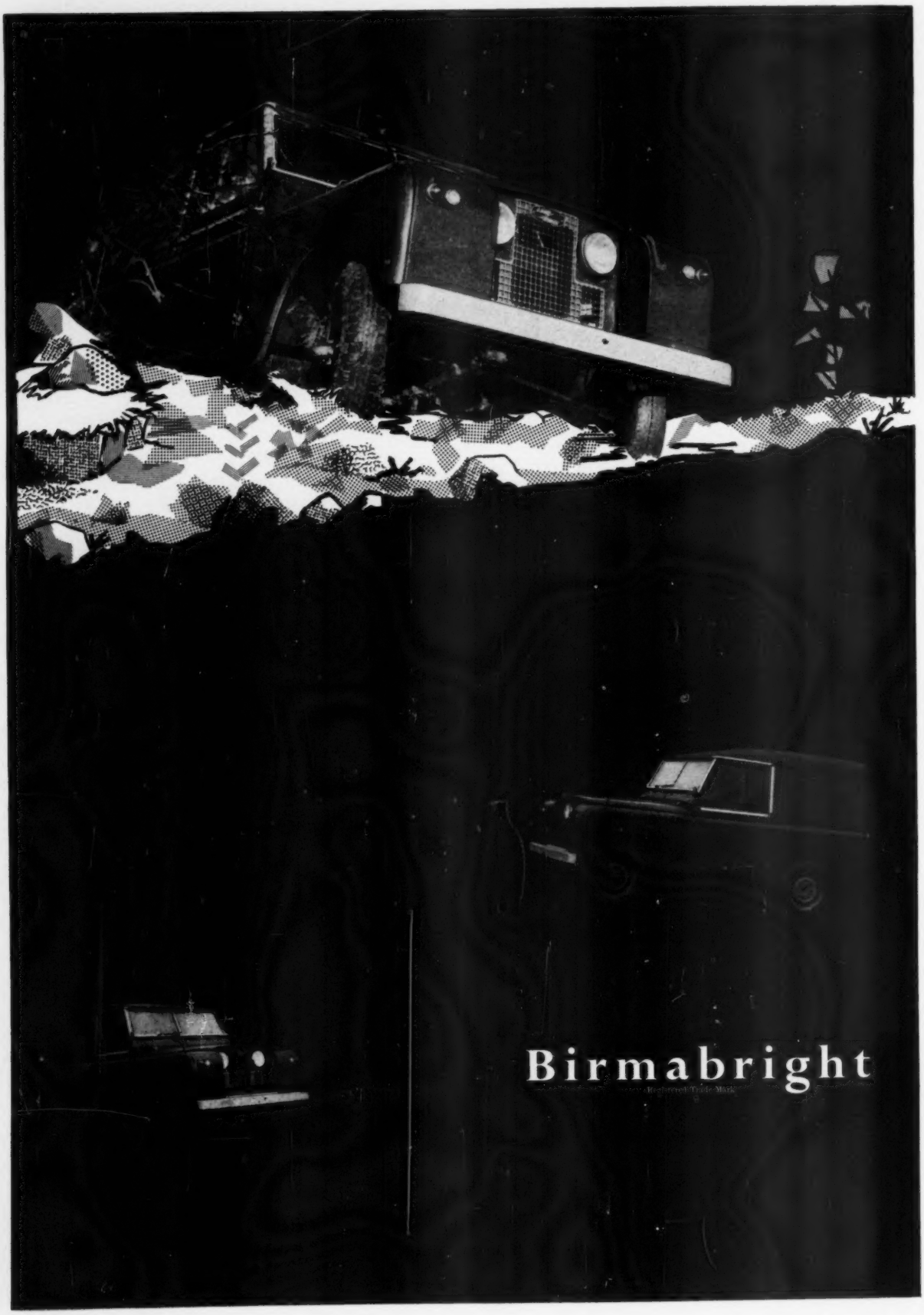
LARGEST MAKERS OF V-BELT DRIVES IN THE COMMONWEALTH

Heat Treatment

In salt bath furnaces, as in greenhouses, brings its rewards. The 'Cassel' Heat Treatment Service offers you the benefits of its experience in carburising, heat treatment, tempering, martempering and austempuring.

Write to:
Imperial Chemical Industries Limited
London, S.W.1.

CC.108


Birmabright

THE *ALL-NEW* ANGLIA by FORD

As major suppliers of rubber/metal units,
Silentbloc Ltd. and their subsidiary,
Andre Rubber Company Ltd.,
are proud to be associated
with the ALL-NEW ANGLIA,
and wish Ford Motor Company Ltd.,
every success
with this impressive new model.

SILENTBLOC

and

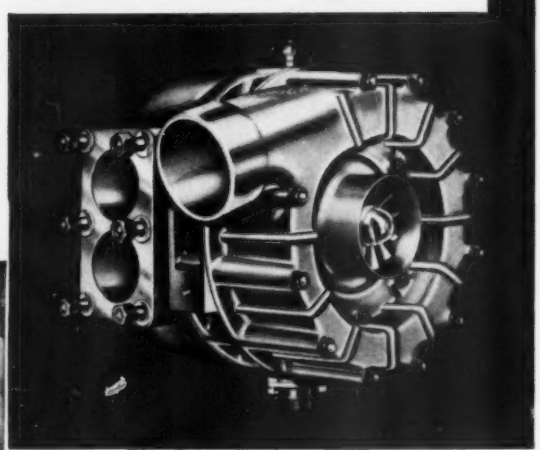
ANDRE RUBBER

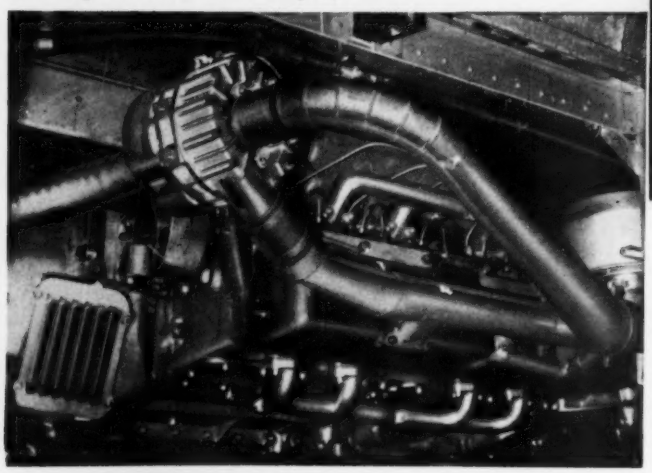
SILENTBLOC LIMITED MANOR ROYAL CRAWLEY SUSSEX
ANDRE RUBBER COMPANY LIMITED KINGSTON BY-PASS SURBITON SURREY

First Coach Service on M.1

uses C.A.V. Turbocharger

The 8-litre S.14 underfloor engine of the Birmingham and Midland Motor Omnibus Co. Ltd., coach is fitted with a C.A.V. radial flow turbocharger and gives a power output of 130 b.h.p. at 1800 r.p.m. and a torque of 440 lb/ft., at 1200 r.p.m., providing the necessary performance for the 3-hour 25-minute, 116-mile economical coach service. (This power is equivalent to that of a 10 litre engine, normally aspirated, with improved maximum torque.)





Increased power for minimum weight

The C.A.V. Turbocharger, using a pressure ratio of 1.8 : 1, weighs only 30 lb, yet gives a power increase equivalent to 24%, with an effective overall saving in weight. C.A.V. fuel injection equipment is fitted and is matched for optimum performance with the Turbocharger.

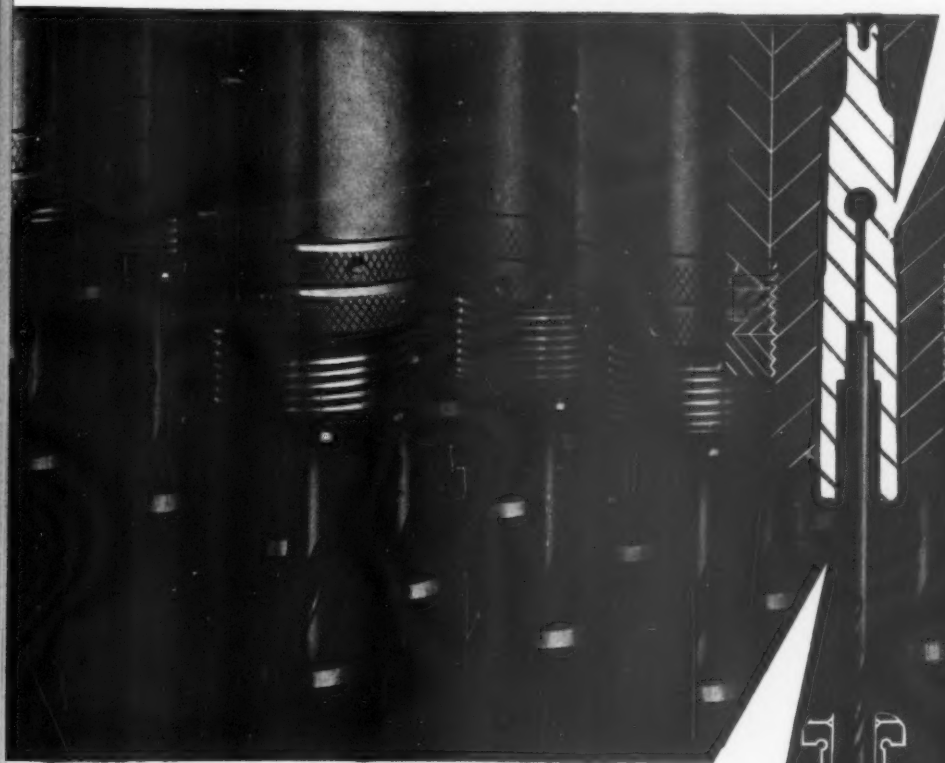
The World's Largest Manufacturers of

FUEL INJECTION EQUIPMENT

C.A.V. LIMITED, ACTON, LONDON, W.3

AP978

ANOTHER DORMER ECONOMY



or repetitive drilling of any particular size of hole, where a taper rive is required, considerable savings can be effected by using a ORMER Conversion Sleeve and straight shank drills with tang. One leeve outlasts numerous drills—replacement straight shank jobber rills are cheaper than those with taper shanks.

dditionally this drive permits drilling to much closer centres than vith the conventional straight shank drill chucks—more holes can be rilled simultaneously.

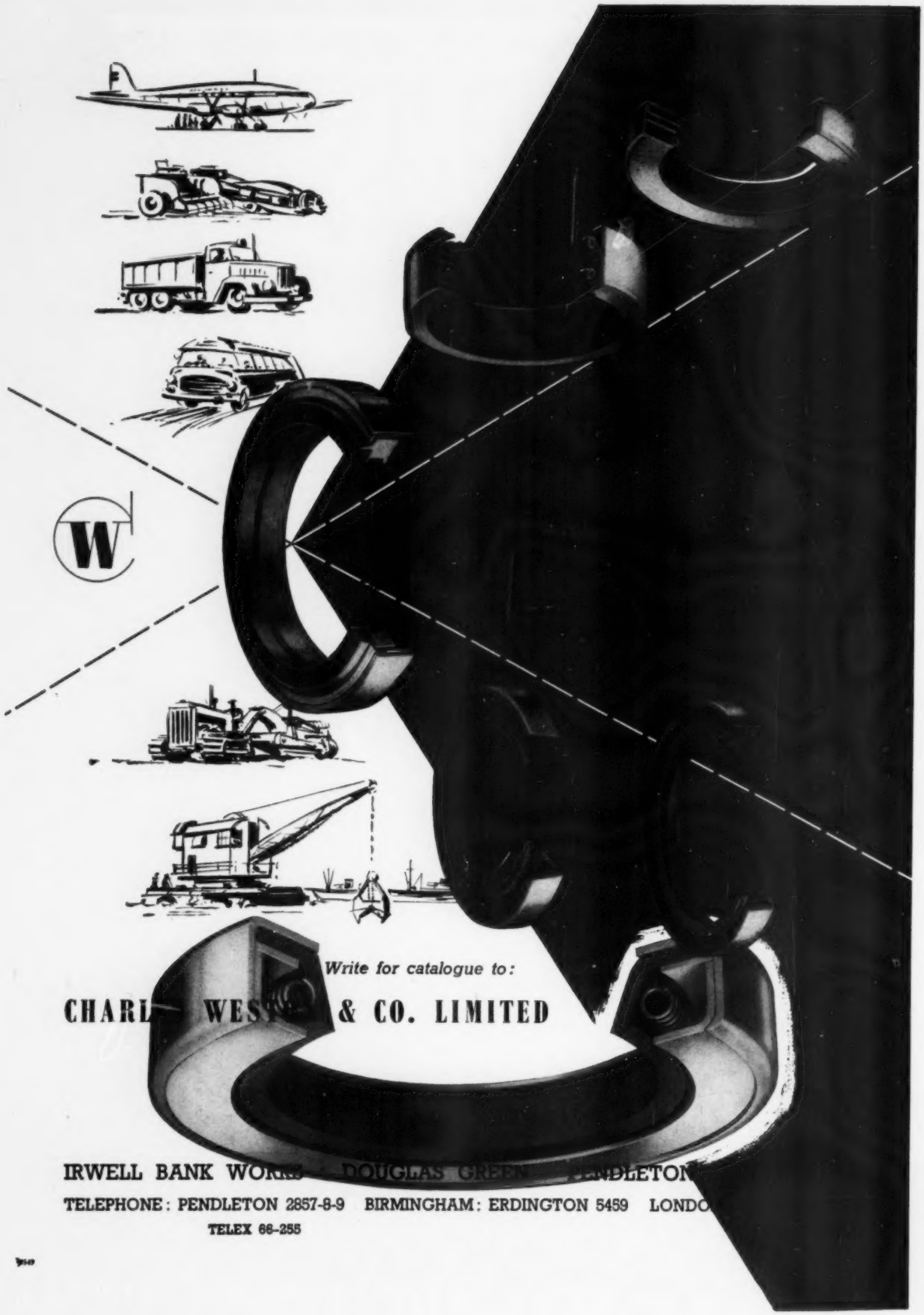
comprehensive range of DORMER Drills are available with tanged traight shanks.

escriptive brochure available.

HE SHEFFIELD TWIST DRILL AND STEEL COMPANY LIMITED
HEFFIELD ENGLAND

ORMER TOOLS ARE OBTAINABLE FROM YOUR USUAL ENGINEERS' MERCHANTS

CONVERSION SLEEVES AND TANGED STRAIGHT SHANK DRILLS



Write for catalogue to:

CHARL— WEST— & CO. LIMITED

IRWELL BANK WORK— DOUGLAS GREEN —NDLETON

TELEPHONE: PENDLETON 2857-8-9 BIRMINGHAM: ERDINGTON 5459 LONDO

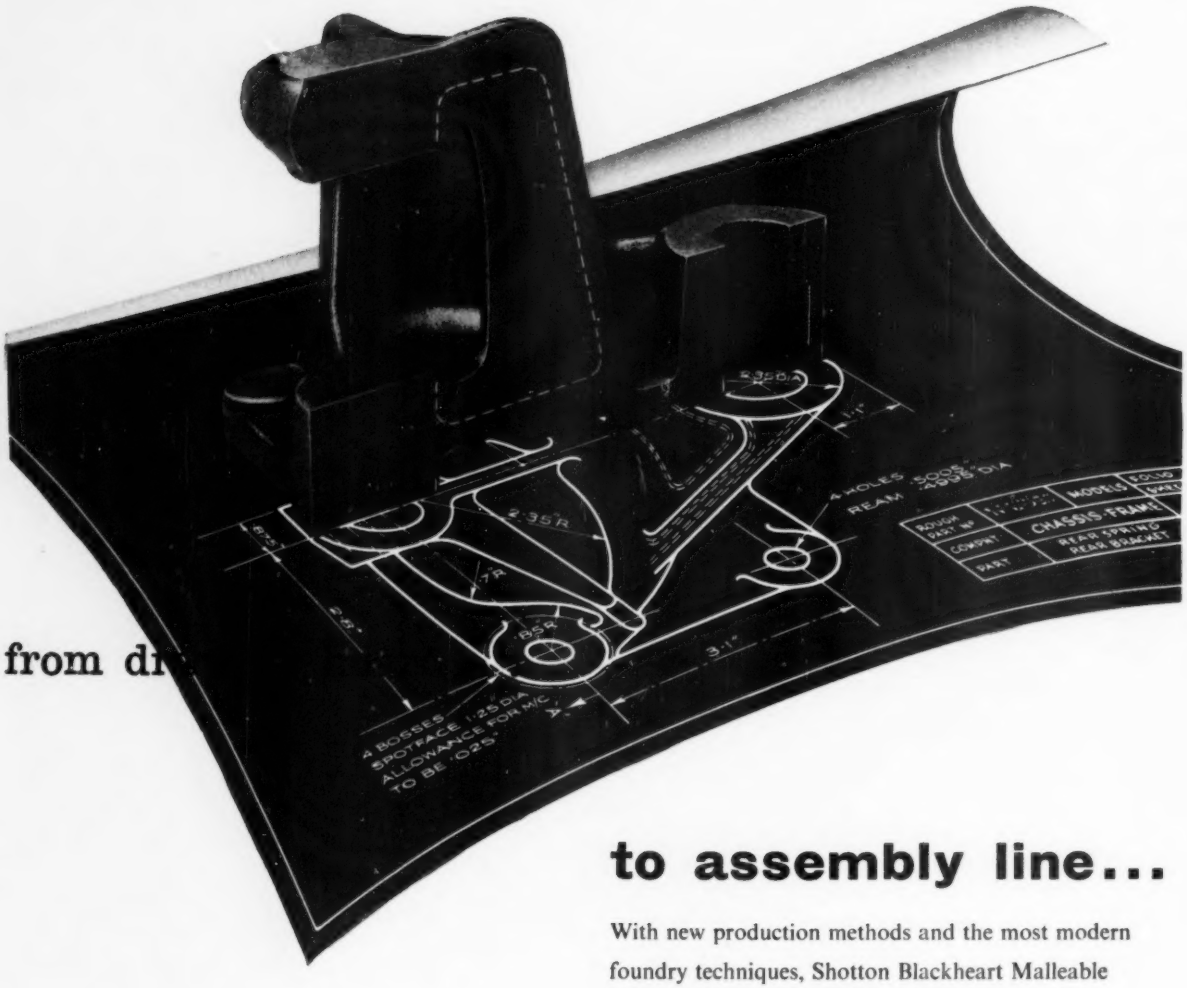
TELEX 66-255

it can be done

Cylinder Head, sand cast in
Hiduminium RR.50 for Rubery, Owen & Co. Ltd.

Hiduminium Aluminium

SHOTTON BLACKHEART MALLEABLE CASTINGS and PEARLITIC MALLEABLE CASTINGS



from di

to assembly line...

With new production methods and the most modern foundry techniques, Shotton Blackheart Malleable Castings have found many new applications in the automotive industry. On design problems and all technical and production matters our consultation, backed by 64 years' experience, is readily available to you.

SHOTTON BROS. LIMITED

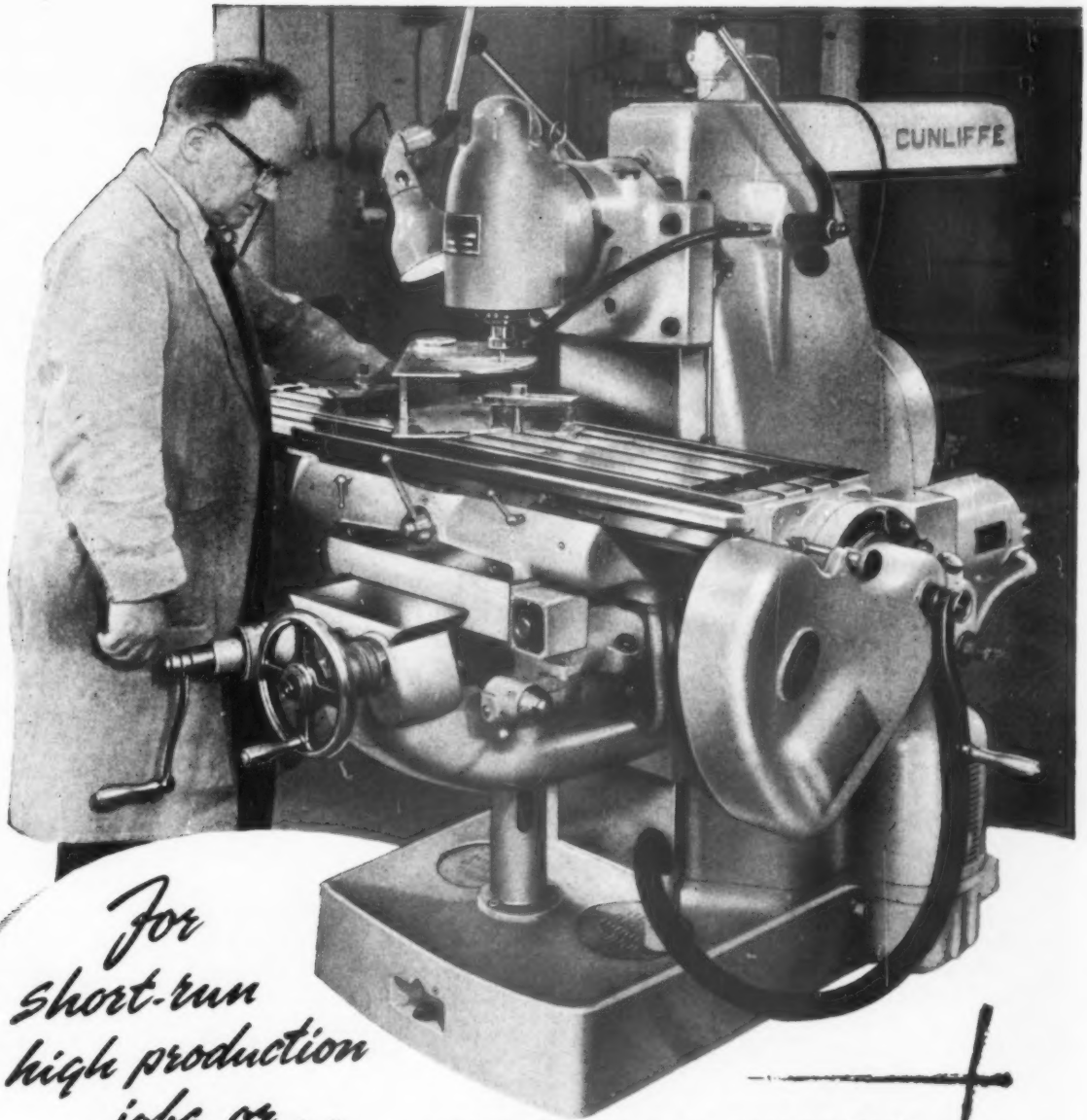
MANCHESTER STREET FOUNDRY

OLDBURY · BIRMINGHAM · PHONE: BROADWELL 1631

(and new foundry at Halesowen)

Member of the Birfield Group

This company participates in the research, technical and productive resources of the Birfield Group, which includes Hardy Spicer Ltd., Laycock Engineering Ltd., Kent Alloys Ltd., Forgings and Presswork Ltd., and many other famous firms.



For short-run high production jobs or --

. . . . or for prototype work as shown, CUNLIFFE & CROOM horizontals, with their in-built features of precision and rigidity, mean increased efficiency wherever they are installed. At the Imperial Tobacco Co., Ltd., Bristol, for instance, this machine, with vertical milling attachment, is fully employed in the Prototype Development Dept., on components for new machines.

CUNLIFFE & CROOM milling machines, horizontal, universal and vertical, are available in a range of sizes to reduce costs on your own work. Complete catalogues available. Write for your copies to-day.

CUNLIFFE & CROOM

HORIZONTAL MILLERS

FULL PARTICULARS OF THESE MACHINES FROM

JAMES ARCHDALE & CO. LTD.

Regd. Office: LEDSAM ST., BIRMINGHAM 16. *Phone:* EDGbaston 2276
Works: BLACKPOLE WORKS, WORCESTER. *Phone:* Worcester 27081 (6 lines)
A Member of the Staveley Coal & Iron Co. Limited Group
Sole Agents: ALFRED HERBERT LTD. COVENTRY. Telephone No. Coventry 89221

"BROOMWADE" presents

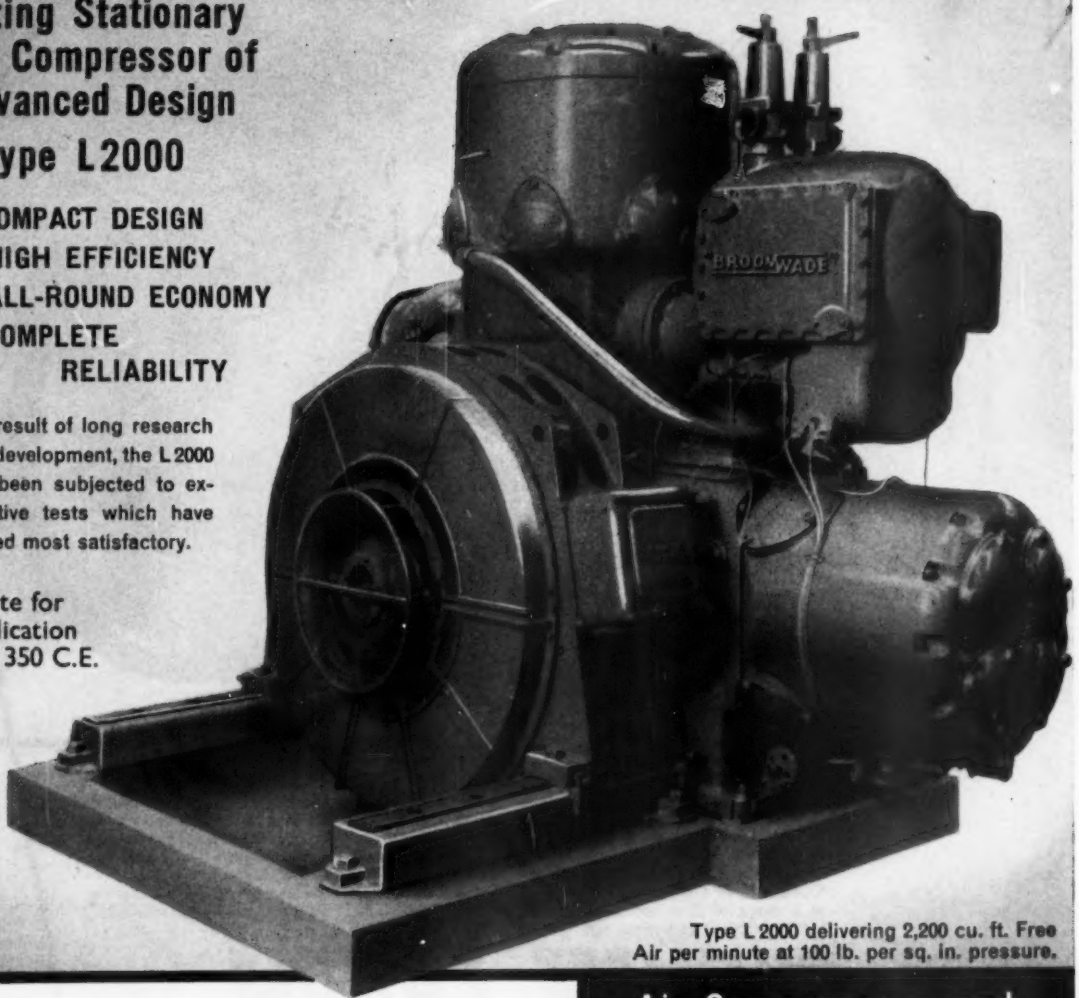
NEW Two-Stage Double-acting Stationary Air Compressor of Advanced Design

Type L2000

★ COMPACT DESIGN
★ HIGH EFFICIENCY
★ ALL-ROUND ECONOMY
★ COMPLETE RELIABILITY

The result of long research and development, the L2000 has been subjected to exhaustive tests which have proved most satisfactory.

Write for Publication No. 350 C.E.



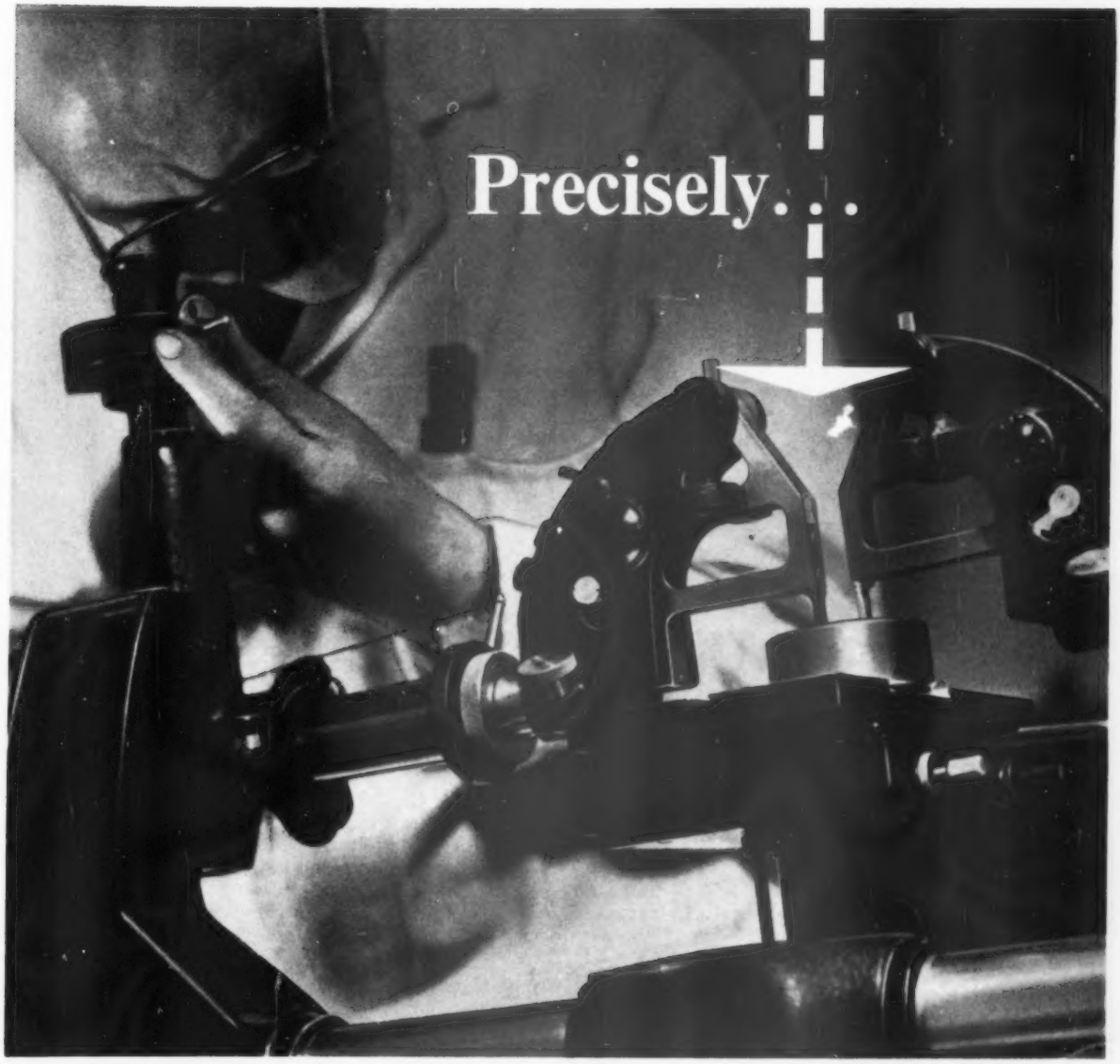
Type L2000 delivering 2,200 cu. ft. Free Air per minute at 100 lb. per sq. in. pressure.

"BROOMWADE"

Air Compressors and Pneumatic Tools
YOUR BEST INVESTMENT

BROOM & WADE LTD., P.O. BOX No. 7, HIGH WYCOMBE, ENGLAND
Telephone: High Wycombe 1630 (10 lines). Telegrams: "Broom", High Wycombe. (Telex)

426 SAS



unequivocal, scrupulous . . .

This is the first in a series of advertisements illustrating some of the factors which combine to give Hepolite products their superior qualities. Production processes at Hepworth & Grandage factories are carried out to within such fine limits that their control requires instruments capable of checking measurements down to 1/100,000″. The picture shows a Zeiss horizontal optimeter being used for this purpose.

. . . . such workmanship is our pride. It is also your assurance — that Hepolite pistons, gudgeon pins, piston rings and cylinder liners are as reliable and economical in operation as man can possibly make them. Hepolite deserves your confidence.

Hepolite engine components are fitted as standard equipment in most British cars, and the range of Hepolite pistons, pins, rings and cylinder liners is the most comprehensive in the world. Please write for details to Dept. D8

HEPOLITE

the first law of engine economics

HEPWORTH & GRANDAGE LIMITED, BRADFORD 4, ENGLAND
Telephone : 29595. 17 lines

KIRKSTALL AXLES

ON THE

ATKINSON OMEGA

6 x 6 TRACTOR

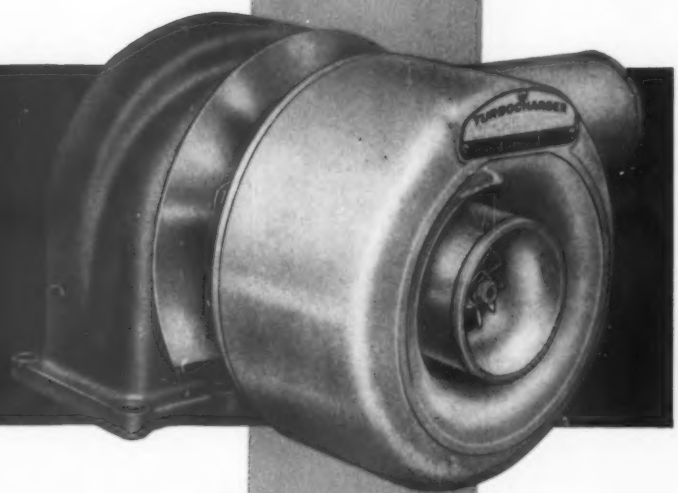
KIRKSTALL FORGE ENGINEERING LTD

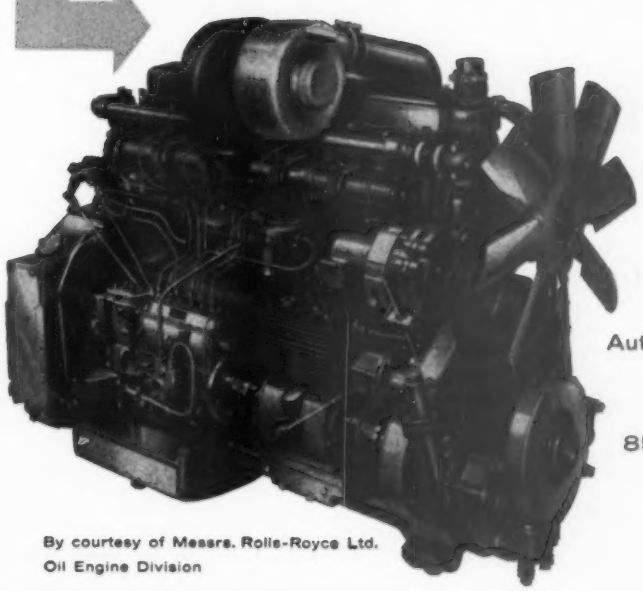
LEEDS

TEL: HORSFORTH 2821

HOLSET Turbochargers chosen by ROLLS-ROYCE for

- ★ Automotive Applications
- ★ Earth Moving Equipment
- ★ Generating Sets
- ★ Marine Propulsion
- ★ Railcars and Shunters





By courtesy of Messrs. Rolls-Royce Ltd.
Oil Engine Division

6-cylinder—12.17 litre
Engine Type C6.T

Automotive Rating (Without Intercooler)
300 H.P. @ 2100 r.p.m.
(bmep = 152 p.s.i.)
850 lb. ft. Torque @ 1400 r.p.m.
(bmep = 172 p.s.i.)

THE HOLSET ENGINEERING CO. LTD.

TURNBRIDGE · HUDDERSFIELD Telephone: Huddersfield 7480. Telegrams: Holset, Huddersfield

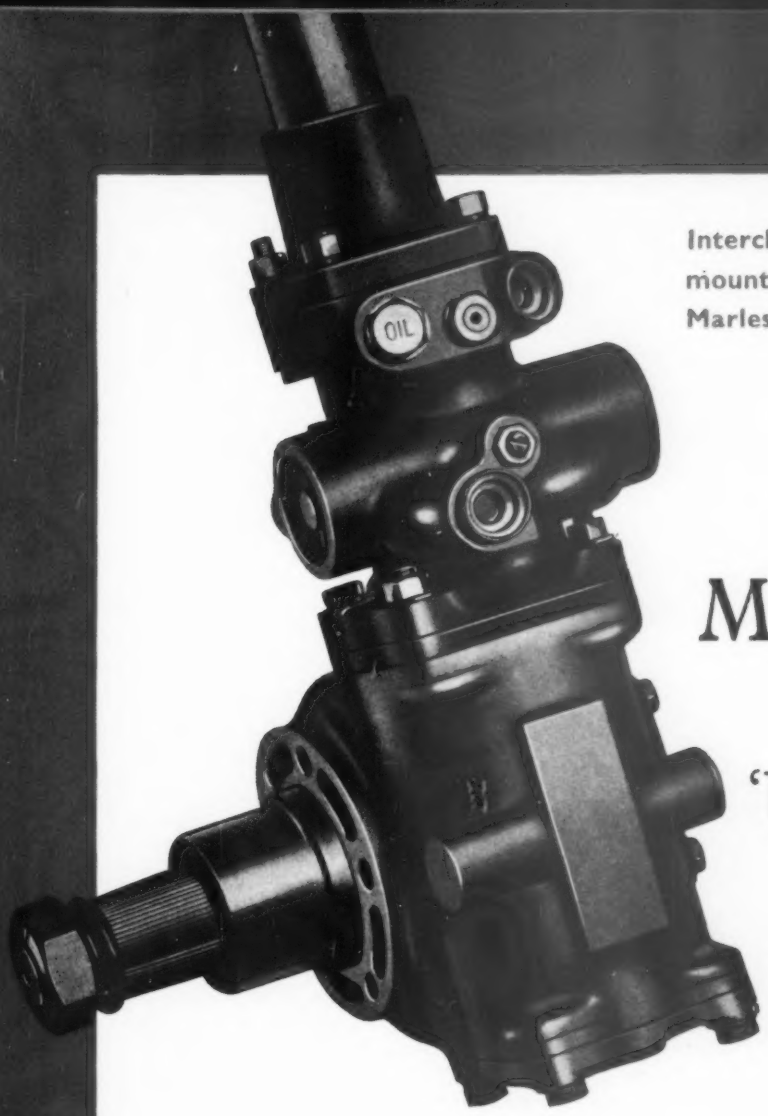
new Lightweight Saffire has many advantages

* *Light to handle*
* *Beautifully balanced*
* *Designed by experts*
* *Precision made*
* *Greater flame stability*
* *Surer resistance to backfire*

BRITISH OXYGEN GASES LIMITED

Industrial Division, Spencer House,
27 St. James's Place, London S.W.1

A BOC Company



Interchangeable, on the same mounting, with the standard Marles manual gear unit.

MARLES type 4 'Universal' power-steering gear

This latest type 4 unit embodies the wide experience of Marles in power-steering, and consists of a 2-valve box mounted on the top of the standard Marles 861 manual gear unit.

The type 4 Universal unit shown above, the type 3 Universal unit and the standard manual unit are all interchangeable on the same mountings.

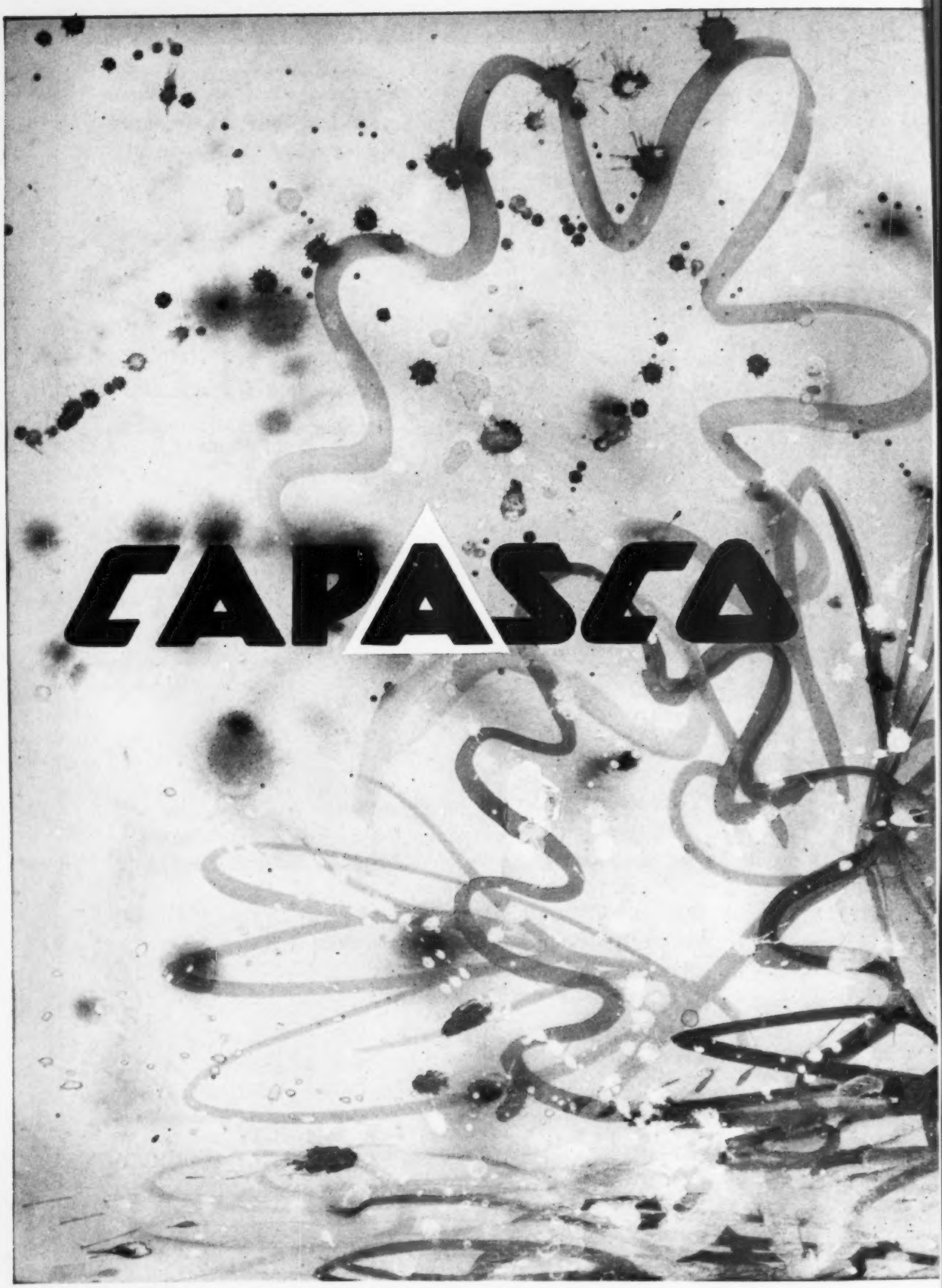
Further particulars will be sent on request.

ADAMANT ENGINEERING CO. LTD.,
THE AERODROME, WOODLEY, Near READING.

Sole proprietors of the Marles Steering Company Ltd.

Telephone: Sonning 2351 Telegrams: Adamant Reading

MARLES

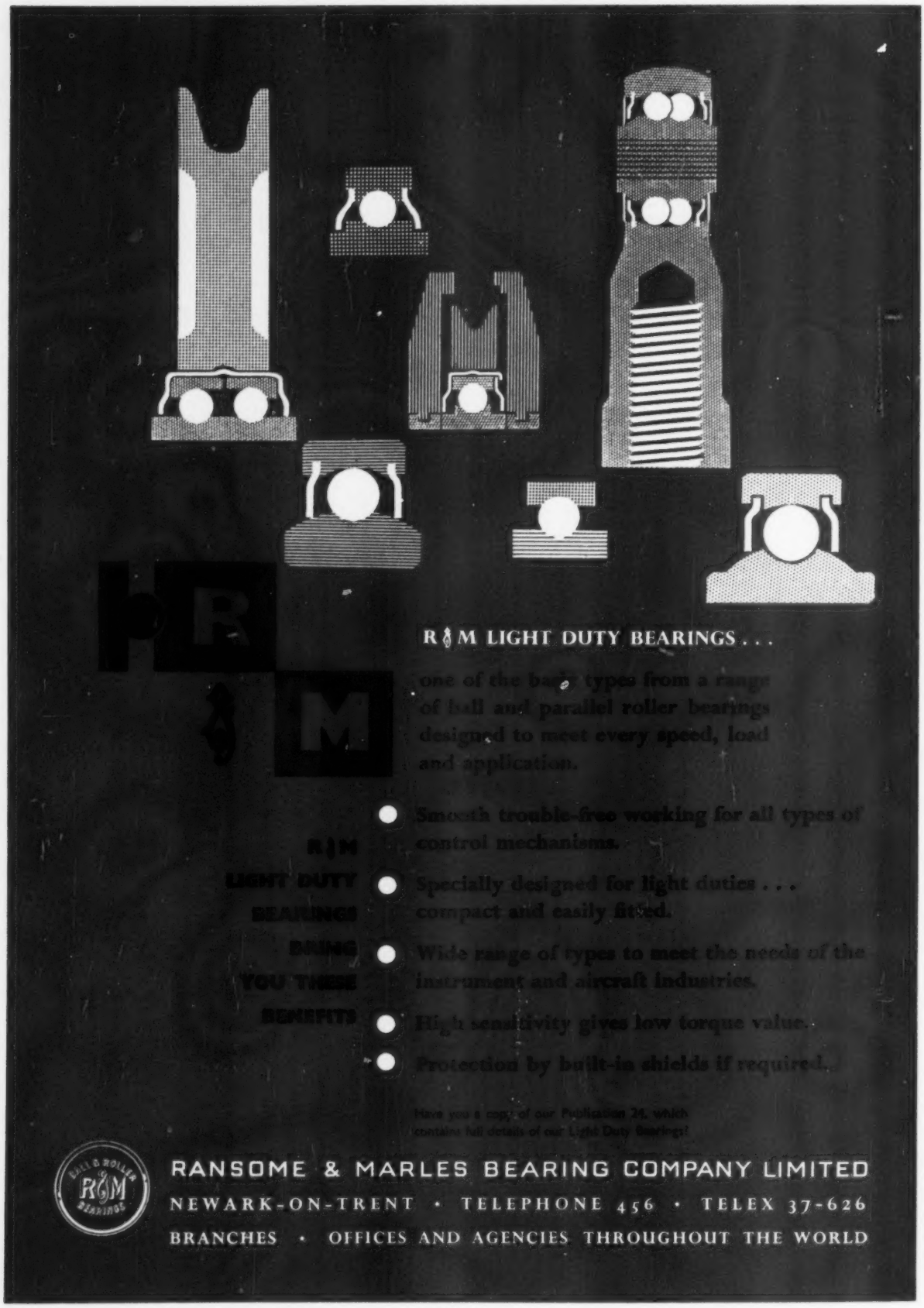

CAPASCO

Capasco takes care of the braking

non-fade moulded linings & facings

THE CAPE ASBESTOS COMPANY LTD

114 & 116 Park Street, London W.1 GROsvenor 6022


R M LIGHT DUTY BEARINGS . . .
one of the basic types from a range of ball and parallel roller bearings designed to meet every speed, load and application.
R M LIGHT DUTY BEARINGS BRING YOU THESE BENEFITS
Smooth trouble-free working for all types of control mechanisms.
Specially designed for light duties . . . compact and easily fitted.
Wide range of types to meet the needs of the instrument and aircraft industries.
High sensitivity gives low torque value.
Protection by built-in shields if required.
Have you a copy of our Publication 24, which contains full details of our Light Duty Bearings?
RANSOME & MARLES BEARING COMPANY LIMITED
NEWARK-ON-TRENT · TELEPHONE 456 · TELEX 37-626
BRANCHES · OFFICES AND AGENCIES THROUGHOUT THE WORLD

FORD FULFILS A FIVE-YEAR PLEDGE

With the completion of its new Paint, Trim and Assembly Building at Dagenham Ford fulfils a five-year-old pledge. This latest plant alone—the most modern of its kind in the world—cost over £10,000,000. Completed earlier, and already at work, are the new Foundry and Body Press Shop, the new Machine Shop at Basildon and the new Parts Depot at Aveley.

The bill for Ford's expansion programme, launched in 1954, exceeds £65,000,000—and millions more will be spent in the next few years. These cash contributions to Britain's future are Ford's pledge that British skills shall continue to lead the world in providing quality vehicles at the lowest possible cost.

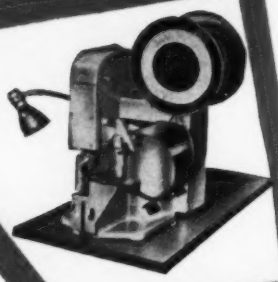
Footnote for Engineers looking to their Future

Men, as well as money, are needed to allow Ford to keep its pledge to Britain—and for the right men Ford's vast expansion offers unique opportunities. If you are a qualified engineer with the creative approach to exciting new problems, write and tell us about your ambitions. Our futures could lie along the same path!

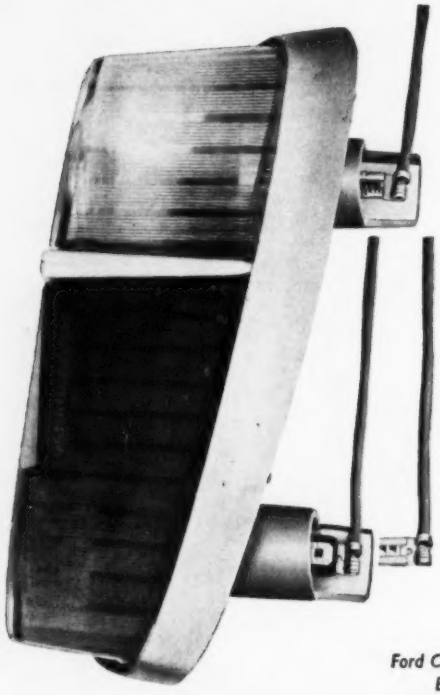
FORD OF DAGENHAM KEEPS FAITH WITH TOMORROW

FORD use

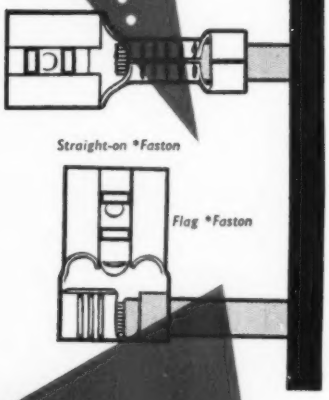
*AMP *FASTONS



the means . . .



Thames Van
rear lamp assembly



Straight-on *Faston

Flag *Faston

Ford Consul de Luxe—
Electrical system
uses both straight-on
and flag* Fastons

. . . to the end

▲ SPEEDY APPLICATION
▲ LOWER APPLIED COSTS
▲ UNIFORM HIGH QUALITY
▲ HIGH ELECTRICAL AND MECHANICAL STABILITY

AMP TRADE MARK

WRITE NOW ABOUT THE **CREATIVE** APPROACH TO BETTER WIRING

AIRCRAFT-MARINE PRODUCTS (GT. BRITAIN) LTD.

London Sales Office: Dept. 12, 60 Kingly Street, London, W.1. Telephone: REGent 2517-8 and 3681-2-3

Works: SCOTTISH INDUSTRIAL ESTATES, PORT GLASGOW, SCOTLAND

*Trade Mark of AMP Incorporated, U.S.A.

AP108

This is Tecalemit isn't it?

TECALEMIT—LUBRICATION, of course. You see the Tecalemit target and arrow sign and take the car in for lubrication service. Grease pumps, pipes, lifts, oil dispensers, air compressors—everything's Tecalemit, right down to the grease nipples. So it's simple: Tecalemit stands for Lubrication.

But Tecalemit stands for filtration
In spite of high compressions, greater loadings and higher speeds, modern car engine bearings can tolerate almost anything—anything except foreign bodies in their oil. Thus the Tec-element: an oil filter element of astonishing efficiency. Most leading British engine manufacturers fit Tecalemit oil filters and so recommend Tec-elements as replacements. Sound advice!

But Tecalemit make precision nylon piping too
Nylon piping for automotive uses was once merely a Good Idea. If only you could use it, it would be cheap, vibration resistant, strong, supple, chemically inert and so on. But how could it be produced to precision limits? Tecalemit found the answer—a resounding and exclusive technical triumph. Nowadays such great names as Austin, Aston-Martin, Ford, Jaguar and Rover use a great deal of Tecalemit extruded nylon piping for fuel lines and vent pipes.

But Tecalemit are famous for oil firing
Oil firing: it takes you out of the automotive field and into the brickworks and kilns. Much tidier brickworks, of course: no heaps of coal and slag. Just pipe runs, control panels, high efficiency and low cost. Oil firing is becoming a major industry in itself—and Tecalemit one of its most prominent names.

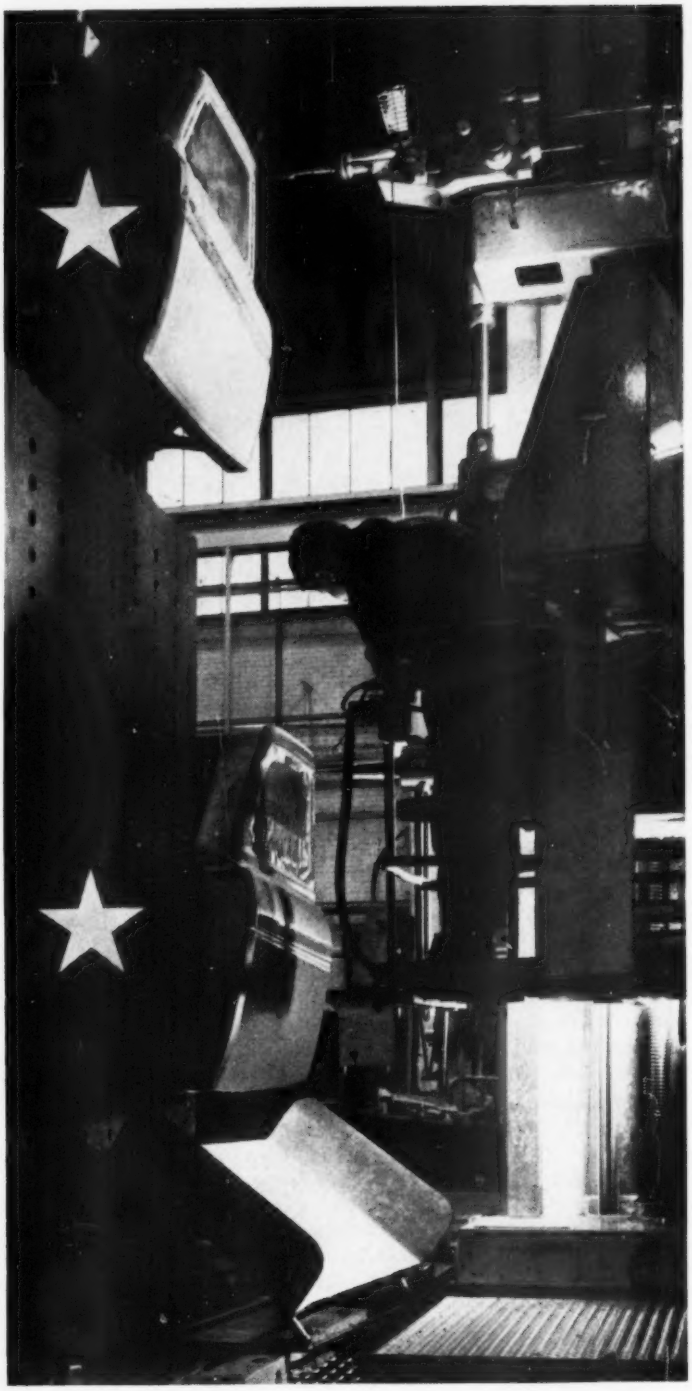
But Tecalemit make a thousand other things
Grease guns, power pumps, hose reels, lifts, sprayers, washing units . . . automatic and multiple lubricating systems for machinery and vehicle chassis . . . air cleaners, breathers and ribbon elements (finest air filtration at lowest cost) . . . in fact, an amazing number of things that help keep industrial and automotive machinery washed, pressured, connected, controlled, raised, lowered, filtered.
Oh yes—and lubricated. For of course Tecalemit stands for lubrication.

TECALEMIT **the Authority on Lubrication – and much else besides!**

Tecalemit Limited · Plymouth · Devon

7489

Identical twins



This die-sinking machine is producing a metal punch for a car door outer panel, from a model made of Araldite epoxy resin. A stylus engages with the Araldite model, and its movements are repeated exactly in producing the metal punch. 4/5 weeks are required for the production of this punch, and the Araldite model retains its dimensional stability, in contrast with the distortion and fragility associated with the use of wood and plaster models. The Araldite unit is tough, durable and does not deteriorate in storage. Further information on numerous applications of Araldite in tool making is contained in a recent publication "Araldite for Tooling" manual B.T., which will be sent gladly on request.

Araldite epoxy resins are used

for producing patterns, models, jigs and tools.
for casting high grade electrical insulation.
for impregnating, potting and sealing electrical windings and components.
for producing glass fibre laminates.
as fillers for sheet metal work.
as protective coatings for metal, wood and ceramic surfaces.
for bonding metals, ceramics, etc.

Araldite

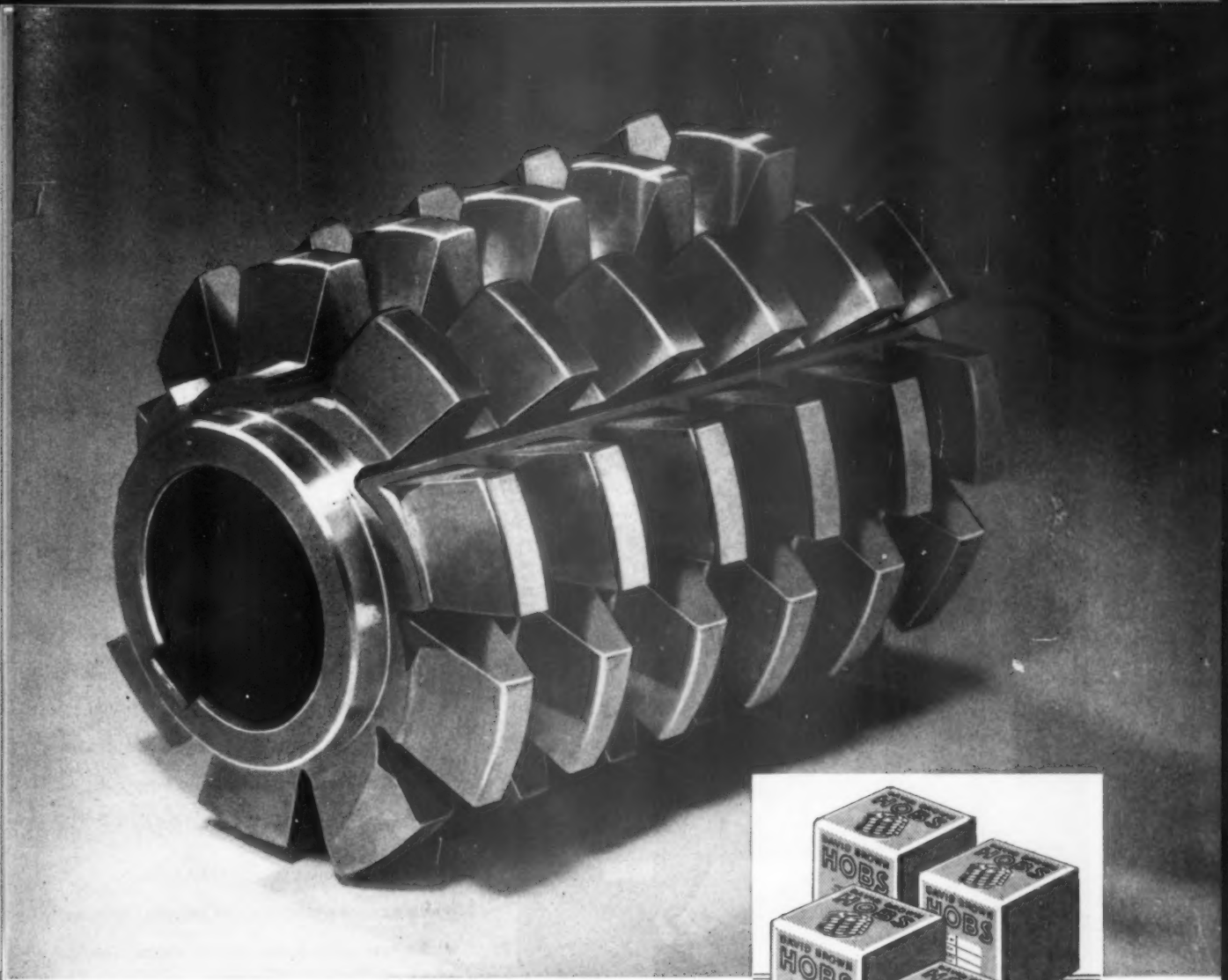
epoxy resins

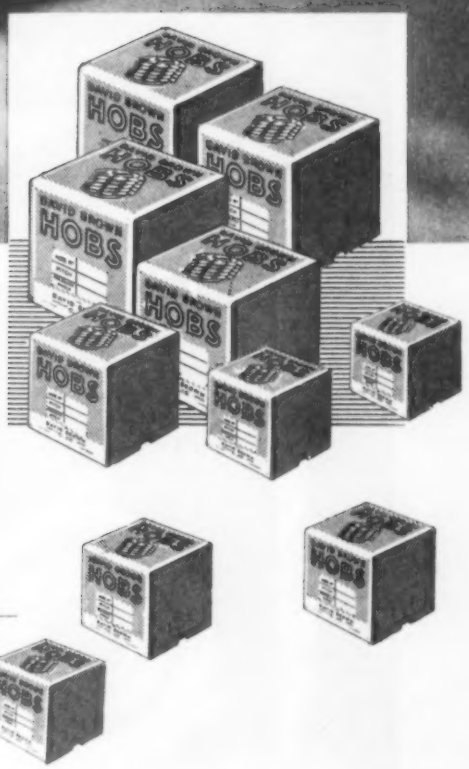
Araldite is a registered trade name

CIBA (A.R.L.) LIMITED,

Duxford, Cambridge. Telephone: Sawston 2121

AP 462





A Whole Life Policy

David Brown, in selling you a batch of Precision Hobs, or even a "one-off," are not intent on just getting off the order book and on to an invoice. They are concerned that their products should give of their best *throughout their whole life.*

To ensure that this happens David Brown maintain the most comprehensive heat treatment, batch and individual inspection procedures—each stage the sole responsibility of a craftsman.

Remember—when you order from David Brown you are calling on nearly a century's accumulated experience. Remember—David Brown for Precision Hobs.

DAVID BROWN

THE DAVID BROWN CORPORATION (SALES) LIMITED

TOOL DIVISION · PARK WORKS · HUDDERSFIELD · TEL. HUDDERSFIELD 3500

D.A. 5709

Get on top of those stresses and strains

by using Saunders-Roe Foil Strain Gauges. For example one application recently carried out by our Foil Strain Gauge Consultancy Service was monitoring of strains in cylinder liners of ship's diesel engines undergoing sea trials.

The judicious use of Foil Strain Gauge techniques can lead to more efficient designs with consequent economies in production and cost over a wide range of industrial activity. Saunders-Roe engineers are actively engaged on this work and can help you with your problems whatever your interests.

Transducers for industrial instrumentation can be supplied with Foil Strain Gauges incorporated to measure, for example, weight, pressure, torque, tractive effort and horsepower.

For details of Saunders-Roe Foil Strain Gauges and Consultancy Service, write to . . .

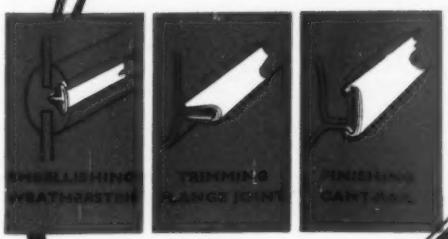
SAUNDERS — ROE

STRAIN GAUGE DIVISION,

OSBORNE, EAST COWES, ISLE OF WIGHT

CPH/SRS/19

A NEW FREEDOM IN DESIGN



is provided by

CLAYLASTIC

the plastic/metal trimming strip

Claylastic by virtue of its flexibility, superb wearing qualities and freedom from damage in assembly, is becoming the natural choice of designers for the external and internal finishing of private cars, commercial vehicles and, in fact, all forms of road transport. Claylastic is found to be the ideal embellishment for glazing rubber, cutting out the need of fillerstrip, and has been established as the perfect finish to flange joints. This material is being used on production lines and has proved its ease of application, and economy in installation. For further details please ask for our brochure Publication 1001.

CLAYLASTIC IS PROTECTED BY BRITISH PAT. No. 801934.

HOWARD CLAYTON-WRIGHT LTD.

WELLESBOURNE · WARWICKSHIRE · ENGLAND

over 20

DU PONT neoprene
PARTS IN THE ROVER 3 LITRE

Rover's famous 3 litre is an outstanding example of the way Du Pont neoprene also plays a part in Britain's go-ahead motor car industry. Du Pont neoprene applications include: steering hose, brake diaphragms, wire coverings, lamp gaskets, suspension dust boots, protective coatings and adhesives. Automobile engineers are doing many interesting things with neoprene, Du Pont's versatile synthetic rubber. They specify neoprene because it offers *balanced* resistance to all the causes of deterioration—including petrol and oil, ozone, sunlight heat and weather. And because it can be compounded and formed in many ways, to perform many specialized functions supremely well. Du Pont neoprene can be utilized in more ways than you may have realized. For a copy of the Du Pont Elastomers Notebook, featuring new developments with Du Pont neoprene, send us the coupon below.

DISTRIBUTORS Du Pont Company (United Kingdom) Ltd, 76 Jermyn Street, London, S.W.1

DU PONT
REG. U.S. PAT. OFF.
ESTABLISHED 1802

neoprene
BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

Du Pont Company (United Kingdom) Ltd.
Room 553, 76 Jermyn Street,
London, S.W.1, England. *Please send me a copy of the Du Pont Elastomers Notebook. I am particularly interested in*

NAME
POSITION COMPANY
ADDRESS
CITY COUNTRY

impact wrench
SIZE 24

Extra strong in design and construction this tool incorporates longer normal working life with minimum maintenance.

Basically designed as a Nut Setting Tool, this Impact Wrench may be effectively used with the available attachments for screwdriving, tapping, drilling, grinding, wire-brushing or sanding.

R29

WRITE FOR LEAFLET I.W.282

BALANCERS · ROTARY AIR DRILLS
ROTARY SANDERS · RIGHT ANGLE NUT SETTERS
RIGHT ANGLE DRILLS · MULTIPLE SPINDLE UNITS

ARMSTRONG WHITWORTH
Power Tools

ARMSTRONG WHITWORTH & CO (Pneumatic Tools) LTD
Main Sales Office: **34 VICTORIA STREET WESTMINSTER LONDON SW1**
Cable Address: ARMWHITOOL SOWEST LONDON *Phone:* ABBey 3817
Works: **TYNEMOUTH ENGLAND** ***Phone:*** **NORTH SHIELDS 3111** ***Grams:*** **ARMWHITOOL TYNEMOUTH**
1603

THE SMALL CYLINDER

THAT DOES A BIG JOB

To meet the demand for a small, powerful and compact air cylinder Schrader's have added to their already representative range a new midget type. This is a double-acting cylinder of 1" bore, with a neck mounting thread for easy assembly in any position. The cylinder and piston are of non-corrodible brass and the general construction is designed to give long trouble-free service under fast, arduous conditions. It is ideally suited for operating jigs and fixtures, transfer and special purpose machines. This cylinder can be supplied from stock with the following piston strokes, 1", 2", 3", 6", 9" and 12".

Compact overall size permits mounting in the minimum space.

●

Popular 1" dia. neck mounting thread complete with lock nut. Fits standard 1" dia. bored holes.

●

Cartridge type bronze bearing and piston rod seal, replaceable without dismounting cylinder.

●

Synthetic rubber "U" cup piston seals—self adjusting.

Schrader **AIR CYLINDERS**

To: **A. SCHRADER'S SON,** Air Control Products Dept. AE, **829 TYBURN ROAD, ERDINGTON, BIRMINGHAM, 24**

Please send details of Schrader Midget Air Cylinders

NAME.....

ADDRESS.....

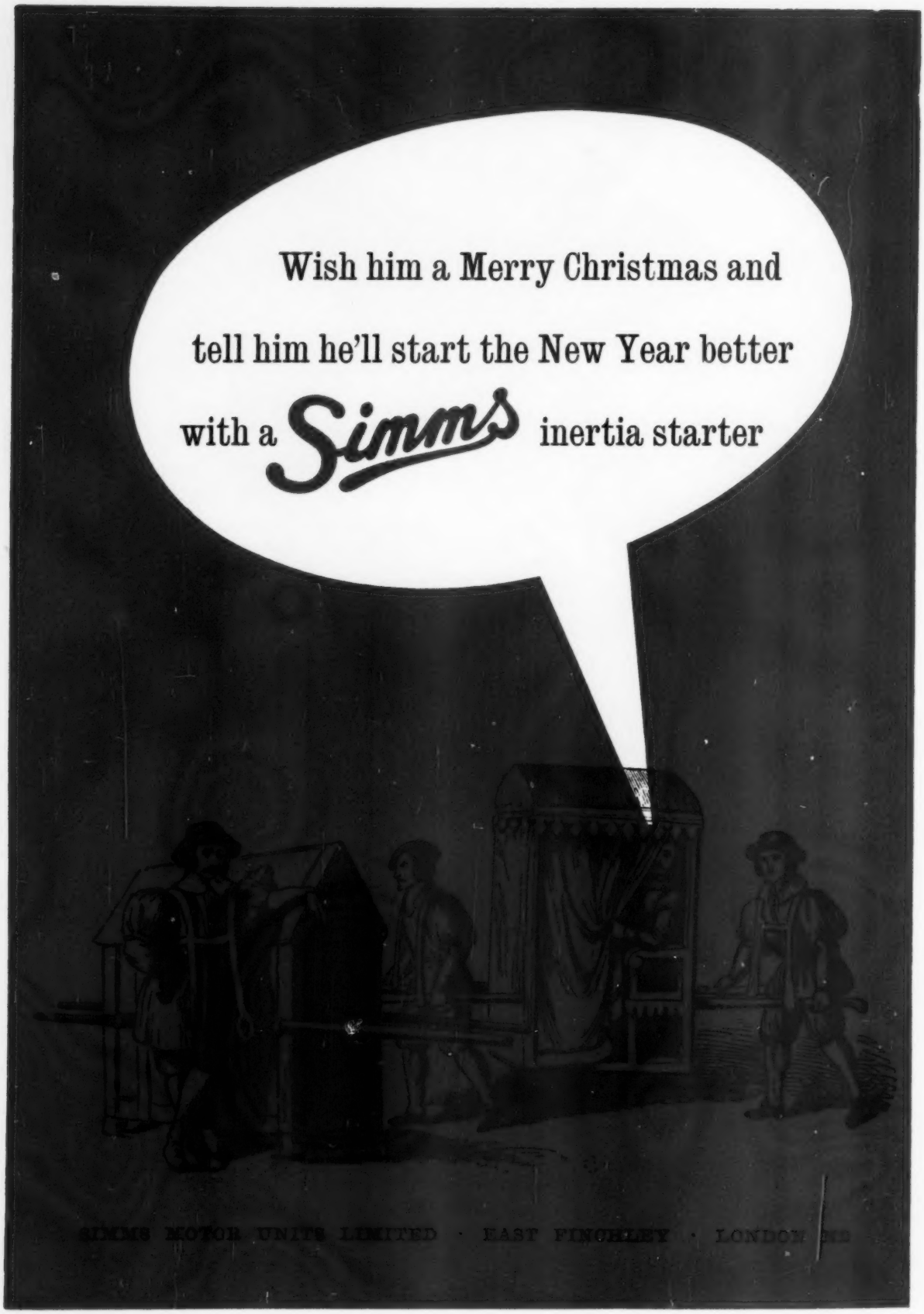
21

...and ends with **FERODO**

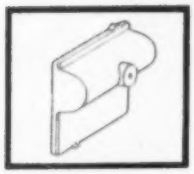
Anti-Fade Brake Linings

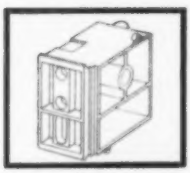
ALWAYS SPECIFY FERODO FRICTION MATERIALS

FERODO LIMITED · CHAPEL-EN-LE-FRITH A Member of the Turner & Newall Organisation


Wish him a Merry Christmas and
tell him he'll start the New Year better
with a Simms inertia starter
SIMMS MOTOR UNITS LIMITED · EAST FINCHLEY · LONDON N2

DMC* electrically...





60 amp. Input Junction Box moulded by Aldridge Plastics Ltd. for Siemens Edison Swan. The four moulded components are shown in the inset drawings.

Beetle Polyester D.M.C., the new fast-curing moulding compound, is especially suitable for moulding electrical components. It has excellent anti-track and electrical insulation properties, high mechanical strength; dimensional stability above normal for thermosetting materials; good heat resistance. Aldridge Plastics Ltd. use Beetle D.M.C. for moulding several types of electrical distribution gear, using conventional compression and transfer presses. Write for technical leaflets.

BEETLE* dough moulding compound

B.I.P. CHEMICALS LIMITED · OLDBURY · BIRMINGHAM · Phone: Broadwell 2061 B·I·P

London Office: Haymarket House, 28 Haymarket, S.W.1 · Phone: Trafalgar 3121

QUALITY CASTINGS

FOR QUANTITY SUPPLY....

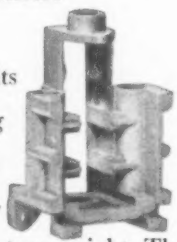
...in Iron or Aluminium Alloy

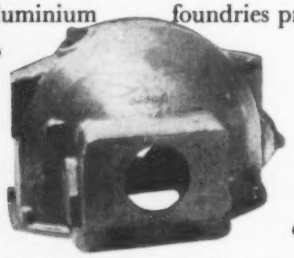
TO MANY INDUSTRIES

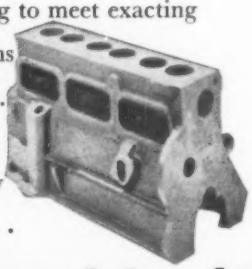
Vehicle Building
Car Manufacture
Aircraft Manufacture
Coal Mining
Machine Tools
Chemical Plant
Railway Plant
Electrical Appliances
Diesel Engines
Shipbuilding
Refrigeration
Domestic Appliances
Textile Machinery
Printing Machinery
Industrial Trucks
Fans, etc., etc.

CAST WELL AND TRUE

Quality castings in grey iron, aluminium alloys and Mazak are supplied in large quantities for a wide range of industries, including the major part of the British motor industry. Our iron foundry has five fully mechanised units designed to handle varying weights and sizes in order to provide maximum economies in mass production. A large floor-moulding section can handle castings up to 5 tons weight. The aluminium foundries produce a large tonnage by sand casting, gravity die casting and pressure die casting to meet exacting conditions of service.





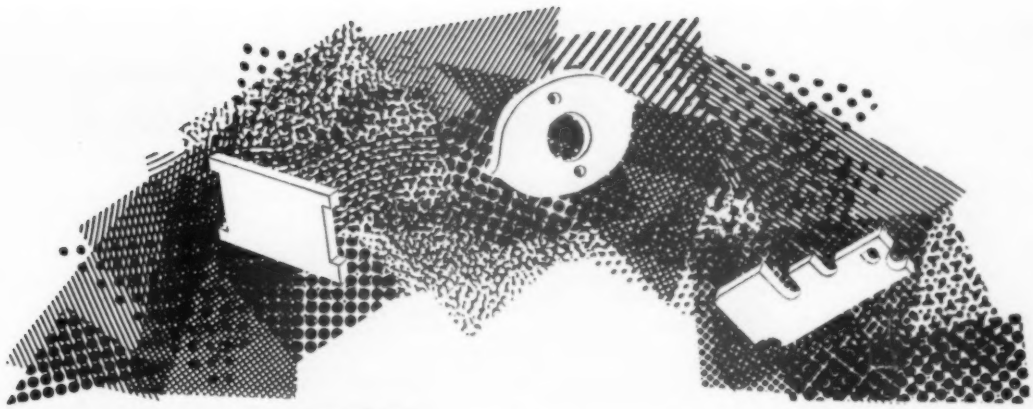


Call us in the next time you require QUALITY castings for quantity supply . . . .

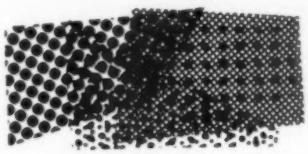
West Yorkshire Foundries Ltd

Sayner Lane Leeds 10
Telephone: Leeds 29466

London Office:
Hanover House · Hanover Square. · W1
Telephone: MAYfair 8561



Let BURY FELT solve your problem



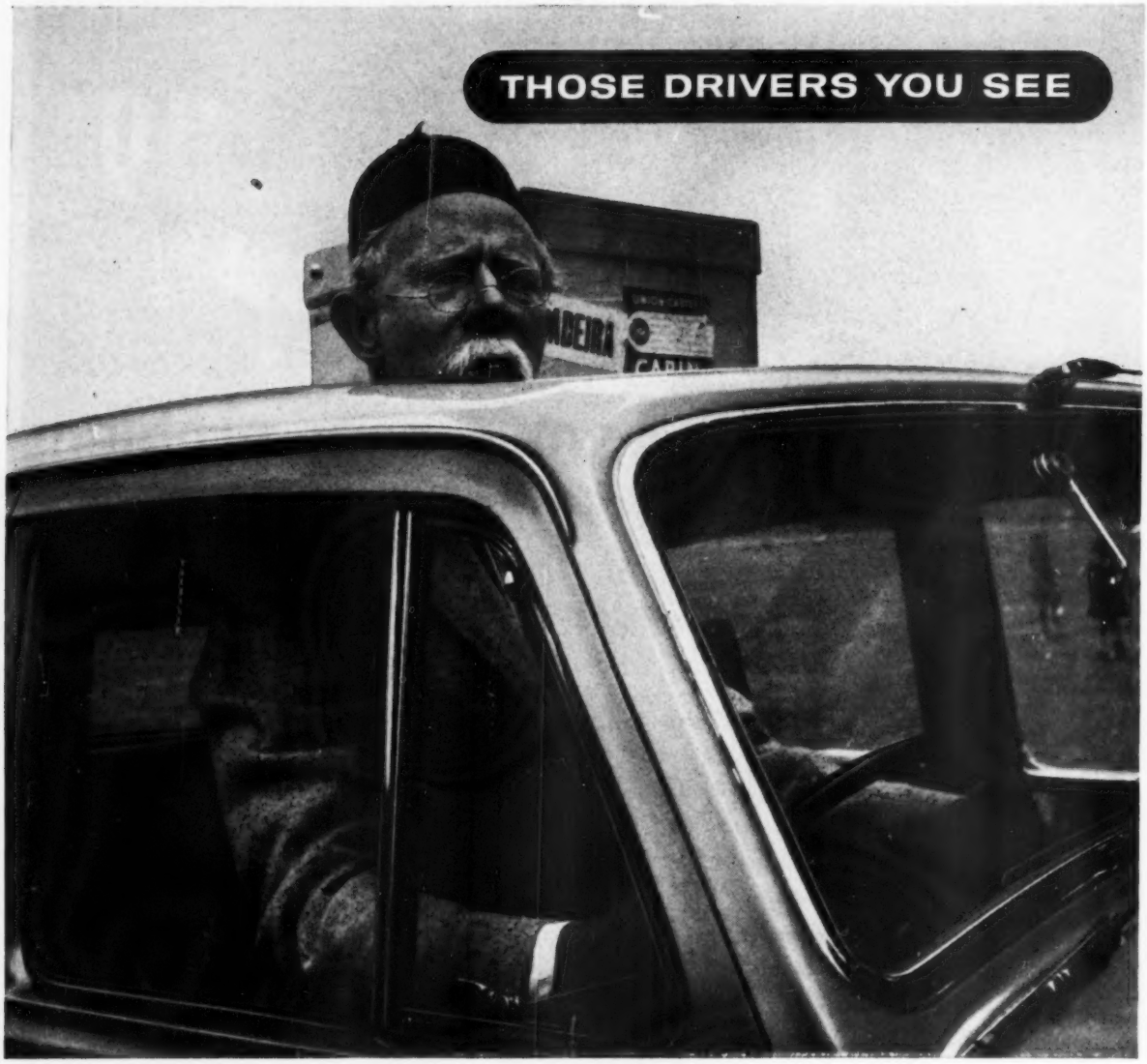
You'll find Bury Felt everywhere—as washers, seals and gaskets, polishing bobs, anti-vibration bases and buffing rollers. These are only a few of its hundred and one uses. You will think of many more. For Bury Felt is what you make of it; it can be chiselled, punched, machined or die-cut to suit your needs and is available in many types and textures.

Versatile stuff—

BURY FELT

Send your enquiries to
BURY FELT MANUFACTURING COMPANY LIMITED,
P.O. BOX 14, HUDCAR MILLS, BURY, LANCASHIRE
Phone: BURY 2262 (6 lines)
London Offices: 3 Snow Hill, EC1.
Phone: CENtral 4448

Also manufacturers of
'FOAMBURY' Plastic Foam products



But-zis-is-ow-we-drive-in-my-country

There are lots of different kinds of driver on the road. A good many different kinds of fuel too. The safest thing to do is to stick to BP Diesel – available at Agency sites throughout Britain. With a Shell and BP Diesel Agency card your drivers can fill up with BP Diesel on credit, or cash at agency rates.

BP DIESEL

PETROL AGENCY DERV

THIS IS THE SIGN THEY SHOULD LOOK FOR

Light-Sensitive Cells

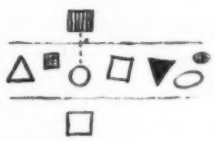
What are light-sensitive cells? They are devices which can sense and measure changes in the level of light or, in some cases, respond to the quality of light falling on them. There are various types of cell and each has its particular field of use. One of the best known is the photo-electric cell.

What can light-sensitive cells do? A change in the amount of light falling on the cell can cause a switch, relay or counter to operate. Alternatively, the direct indication of the light intensity can often allow some other factor to be determined and, if required, controlled. They are reliable and require little maintenance. Careful installation, as with all types of equipment, gives a good reward.

How can they be used? These cells have many applications in industry, for controlling processes, for inspection and measurement, for sorting material and for safety purposes:

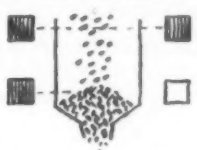
Counting

Where objects on a conveyor belt are too soft or light to operate a direct mechanical counting device, where they are too delicate or freshly painted to sustain physical contact or where the articles vary in size, a light-sensitive cell can be used. This counts the objects by interruption of an appropriately sited beam of light.



Hopper or Tank Level Control

Many forms of feed can be accurately controlled by light cells. One important one is for controlling the input to a hopper of fluid solids such as sand or peas. Here, two horizontal light beams are required: the upper, when interrupted, indicates that the hopper is full and stops the supply; the lower, when it ceases to be interrupted, indicates that the hopper is nearly empty and restarts the flow.



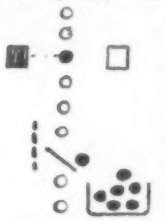
Package Content

The level of powder in packages can be checked with light cells. The cell is so positioned that when the

powder is up to the required level, the light reflected from the surface of the powder is picked up by the cell and causes the carton to be accepted. If not, it is rejected.

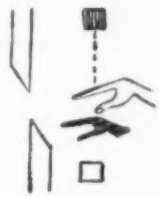
Colour Sorting

The quality of many articles can be gauged by their colour—seeds and nut kernels, for instance. The objects are fed into a tube by means of a vibrator pan and fall into the beams of three equally spaced light cells which scan them from all sides. If the object is acceptable it falls into a chute carrying it to one conveyor; if its colour is bad it is deflected as a reject.



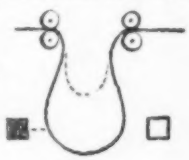
Guillotine Guard

Light cells for guarding a guillotine or power press should be used only as a supplement to a mechanical guard or where the latter is impracticable. The interruption of a curtain of light by a hand stops the machine instantaneously.



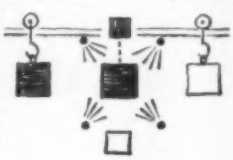
Press Feeding

Where the rate of feed of strip metal must be suited to a varying speed of acceptance by a press, a loop of the strip is allowed to sag between the feed and the press. When the loop reaches a predetermined depth a light beam is interrupted and the slack is taken up.



Processing Objects on the Move

Many articles are processed while on a conveyor line. For instance, where articles are to be sprayed while on the conveyor, the paint saved by stopping the gun between articles will make the device worthwhile. The same principle applies in a bakery to the spraying of baking tins with fat.



Automatic Door Opening and Closing

Doors can be caused to open or close by the interruption of a beam of light. This has its uses in such cases as control of doors on a heating oven or for the passage of vehicles in a factory. This is effected by a light beam on the side from which the approach is made (in many cases, both). When the approach beam is interrupted it opens the door which closes again after a given time interval.

For further information, get in touch with your Electricity Board or write direct to the Electrical Development Association.

An excellent series of reference books are available (8/6 or 9/- post free) on electricity and productivity — "Higher Productivity" is an example. E.D.A. also have available on free loan a series of films on the industrial uses of electricity. Ask for a catalogue.

Issued by the Electrical Development Association
2 Savoy Hill, London, W.C.2

F8569

CUT HERE

Once upon a time at Exhibitions, Buyers were instantly attracted to the **Desoutter** stand by the noise of the pneumatic screwdrivers.

But who wants noisy screwdrivers?

And so . . . spending a whole week's tea money on research our M.D. sweated and slaved, starved, went hungry, turned white before his time, and finally emerged triumphant, the inventor of the **silent Desoutter screwdriver!**

Wasn't it Shakespeare who said 'Never make a silent screwdriver—no one will ever hear it'?

Desoutter Bros. Ltd., The Hyde, Hendon, London N.W.9. Telephone: Colindale 6346

CBC 322

LEY'S

Tested at 2,500 p.s.i.

The illustration shows a valve body for use in hydraulic control equipment. The complex nature of this valve body involves a great deal of machining; at the same time high mechanical strength is an important factor, since the valves are used at a high working pressure and are tested at 2,500 p.s.i.

These considerations led to the choice of castings in 'Lepaz 35', a pearlitic malleable which combines excellent machinability with an ultimate stress of 33/38 tons sq. inch and an elongation of 6-8%.

LEY'S MALLEABLE CASTINGS CO. LTD.. DERBY. TELEPHONE: DERBY 45671.

STRENGTH & RIGIDITY

LEY'S

DOWTY

'O' RINGS

also

'U' RINGS · SQUARE-SECTIONED RINGS
MOULDINGS AND BONDINGS

Natural, synthetic
and silicone rubbers

DOWTY SEALS LIMITED · ASHCHURCH · GLOS.

METALASTIK CONTRASONIC SPRING SHACKLES

PATENT APPLIED FOR

Isolating road noise

It is the *volume* of rubber that is the determining factor in isolating road noise.

Here are two very successful Metalastik components; the Contrasonic spring shackle, evolved for the 3-litre Rover and the Metaxentric bush. The construction of the Contrasonic shackle is self-evident, also the canting of the twin units to resist lateral stresses. Fore-and-aft movement, as the leaf spring changes in length, is accommodated by the rubber in shear; weight by combined compression and shear.

A Metaxentric bush in the front eye of the spring and a Contrasonic shackle at the rear provides the most effective barrier yet devised against the transmission and amplification of noise.

METAXENTRIC BUSHES

First fitted in spring eyes by the Standard Motor Company, Metaxentric bushes give much higher vertical deflections than concentric types. In fore-and-aft directions they are stiffer than in the vertical plane, the ratio being about 2·5 to 1.

PATENTED

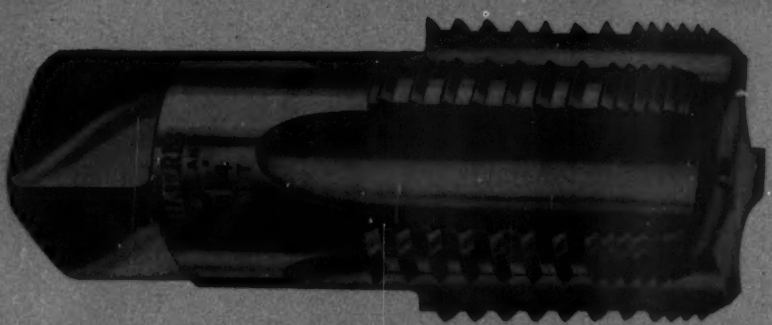
METALASTIK

METALASTIK LTD., LEICESTER

HARRIS

TAPS DIES AND GAUGES

FROM STOCK



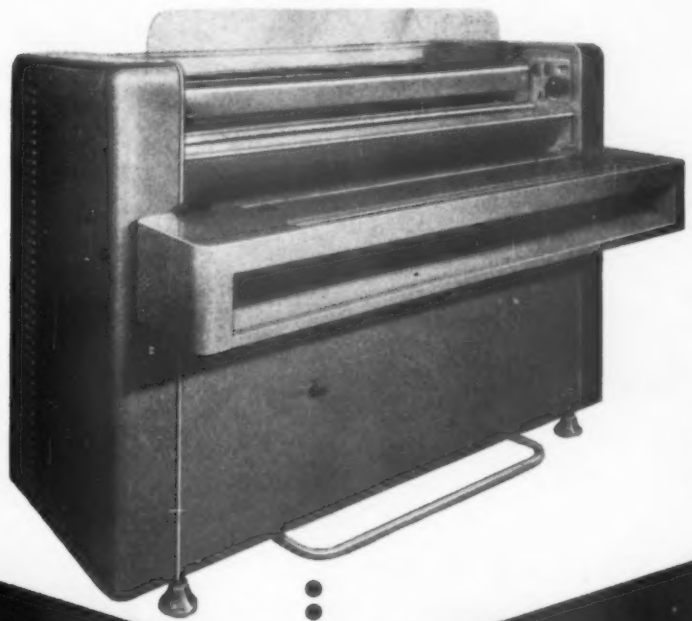
Have you tried Harris Tapping lubricants? Available in 2-oz. (9d). 7-lb. (13/3d) and 28-lb. (47/-) packs.

JOHN HARRIS TOOLS LTD WARWICK

Rapid, high-quality photoprinting

The Ilford AZOFLEX Model 221 Combine printing and developing machine (formerly known as Model 42/63 Mark II) employs safe, odour-free AZOFLEX chemicals—just one of the many special features that make it the ideal photoprinting machine for print room or drawing office.

- Exposing, developing and drying operations completely synchronized.
- All controls accessible from comfortable working position.
- High continuous output easily maintained by one operator.
- Excellent copies obtainable from old or faded originals.
- Comprehensive maintenance service available at nominal cost.



and no unpleasant fumes

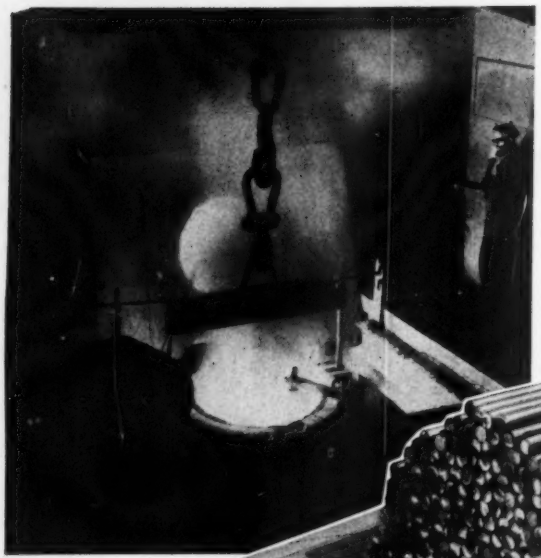
Capacity: rolls and cut sheets up to 42 in. wide. Printing speed: 6 in. to 15½ ft. per minute. Lamp: H.P.M.V. MA/U 2,000 watt. Dimensions: height 50in., width 67in., depth (tray extended) 52in. Weight: 850 lb.

Subject to certain conditions, the majority of AZOFLEX photoprinting machines can be hired as an alternative to outright purchase.

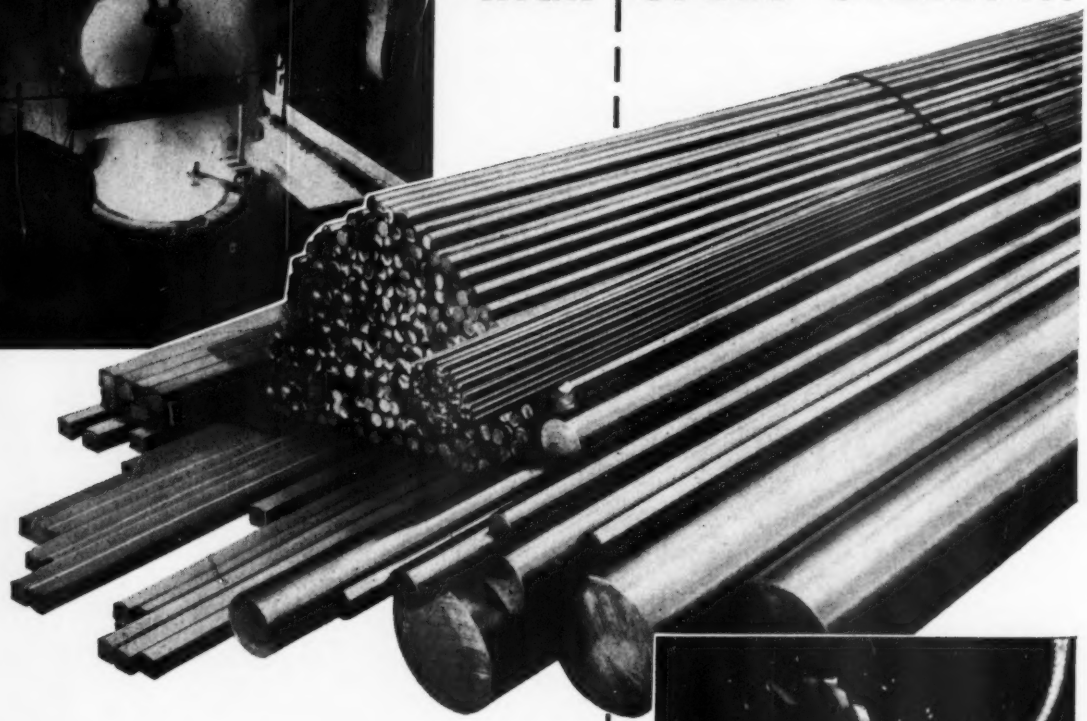
ILFORD *Azoflex*

PHOTOPRINTING MACHINES & MATERIALS

Full details from
ILFORD LIMITED, INDUSTRIAL SALES DEPARTMENT AZ17C
ILFORD, ESSEX. TELEPHONE: ILFord 3000



SPEEDICUT
HIGH SPEED STEELS...



...for all cutting tools

The high production rates achieved in cutting both soft and hard materials in the modern machine shop are in a large measure attributable to the efficient use of high speed steel tools.

Firth Brown high speed steels are distinguished among tool materials by their ability to develop by appropriate heat treatment an outstanding combination of the principal characteristics required in cutting tools, namely hot hardness, wear resistance and toughness, enabling them to retain their cutting ability at speeds, feeds and depths of cut.

There is a Firth Brown high speed steel for your every need — write for Publication No. 224 (Section 7) for further details.

by

FIRTH BROWN

ALLOY STEELMAKERS • FORGEMASTERS • STEEL FOUNDERS • HEAVY ENGINEERS

THOS. FIRTH & JOHN BROWN LIMITED · SHEFFIELD · ENGLAND

A Metrovick radiant space heater suspended on conduit.

Warmth

projected where and when you want it!

Metrovick radiant space heaters project warmth where it is needed and for garage heating they offer many advantages over other forms of heating.

General space heating: Radiant heat does not heat the air but only the people or objects on which the heat rays fall, and where large garage areas are concerned, it is possible to heat just those areas where operatives are working. Heaters in unoccupied areas can be switched off until required. When they are required, the heat is available almost instantly.

Benches: In many garages, repair benches are located along the side walls. Space heaters can provide efficient local heating for the mechanics, impossible by other methods.

Petrol pumps, canopies, outside repair yards: The Metrovick space heater is the only weatherproof unit available. In locations where petrol vapour is likely, care must be taken in the siting of the units to avoid contravening Petroleum regulations.

Showrooms: Where a more attractive appearance is required than is provided by the strictly utilitarian industrial space heater, an ornamental bezel can be supplied in polished aluminium.

The Metrovick radiant space heater is available from stock in 1½ kW loading—£9.16.6 · 3 kW loading—£10.17.6

Associated Electrical Industries Limited
TRANSFORMER DIVISION — HEATING & WELDING DEPARTMENT
Trafford Park - - - Manchester 17

TGA L/1805

Tough as the rock

COR-TEN CAN TAKE IT

Super-tractor shovel shifting rocky overburden (Photograph by courtesy of Michigan (Great Britain) Limited)

WHEREVER you see steel taking savage punishment, the chances are it will be SCW Cor-Ten from The Steel Company of Wales.

With good reason. For over the past four years SCW Cor-Ten has built up a solid reputation for sheer toughness. More and more designers and users are specifying SCW Cor-Ten where high yield strength and corrosion and abrasion resistance are of major importance.

Cor-Ten is tougher

- Weight for weight, the yield strength is 50% higher than ordinary mild steel
  alternatively: Strength for strength, a saving of ⅓ of the weight is possible
- 4-6 times more resistant to atmospheric corrosion
- Highly resistant to abrasion and fatigue

Please write to us at the address below for further information or for technical assistance in the application of SCW Cor-Ten to your products

S·C·W BRAND Cor-Ten

RAILWAY ROLLING STOCK
AGRICULTURAL AND EARTH-MOVING EQUIPMENT
MINE CARS · POWER STATION INSTALLATIONS
BARGES AND SMALL CRAFT

THE STEEL COMPANY OF WALES LIMITED

ABBEY WORKS, PORT TALBOT, GLAMORGAN TELEPHONE: PORT TALBOT 3161

DISTRIBUTORS OF MATERIAL IN BULK
IN GT. BRITAIN

J. A. NORDBERG LTD

171 QUEEN VICTORIA ST
LONDON, E.C.4
Tel: Central 9678

FOREIGN & COLONIAL ENQUIRIES TO

H. JACKSON LTD

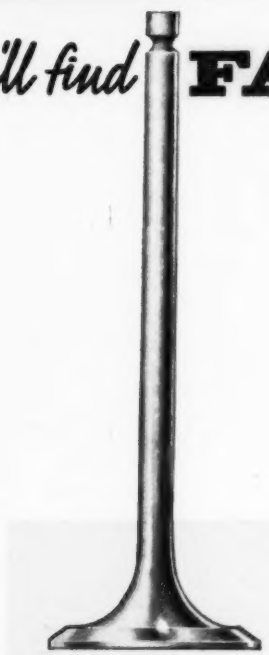
OAKENCLOUGH, GARSTANG
Nr. PRESTON, LANCS.
Tel: Garstang 3308

INVERESK GROUP

Photograph by kind permission of Dodge Bros. (Britain) Ltd.

You'll find **FARNBOROUGH** *valves*

on the production lines of the following engine builders



ADMIRALTY	GLENIFFER
A.E.C.	LEYLAND
ALLEN	MIRRLEES
ALLEY & MACLELLAN	McLAREN
ALLIS CHALMERS	NATIONAL GAS & OIL
BERGIUS	NORTH BRITISH LOCOMOTIVE
DAVID BROWN	PERKINS
CATERPILLAR TRACTOR	RUSTON & HORNSBY
CHRYSLER-DODGE	SCANIA VABIS
CUMMINS	VICKERS-ARMSTRONG
DAVEY, PAXMAN	VOLVO
GARDNER	etc. etc.

FARNBOROUGH ENGINEERING CO. LTD · FARNBOROUGH · KENT

MIDCYL RESEARCH

helps smooth out problems

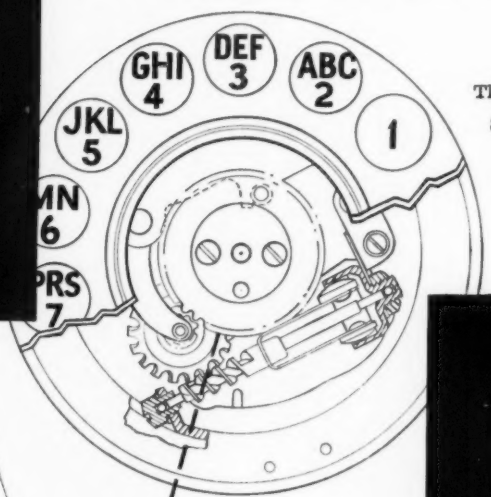
although the Auto Engineer's lot may never be carefree as a kitten's it is the continual research of such people as Midcyl that helps smooth out his problems associated with Cylinder Blocks, Cylinder Heads, Camshafts and Brake Drums

MIDCYL

THE MIDLAND MOTOR CYLINDER CO. LTD., SMETHWICK, STAFFS

Vital links in controlled movement

A body needs muscles to control movement in very much the same way as a mechanism needs springs. These vital links take the stress and strain of every day rigorous use — nature provides the muscles . . . SALTER provides the springs. Two centuries of experience and development in the manufacture of springs of every type have enabled us to keep ahead of the ever-changing requirements of industry.



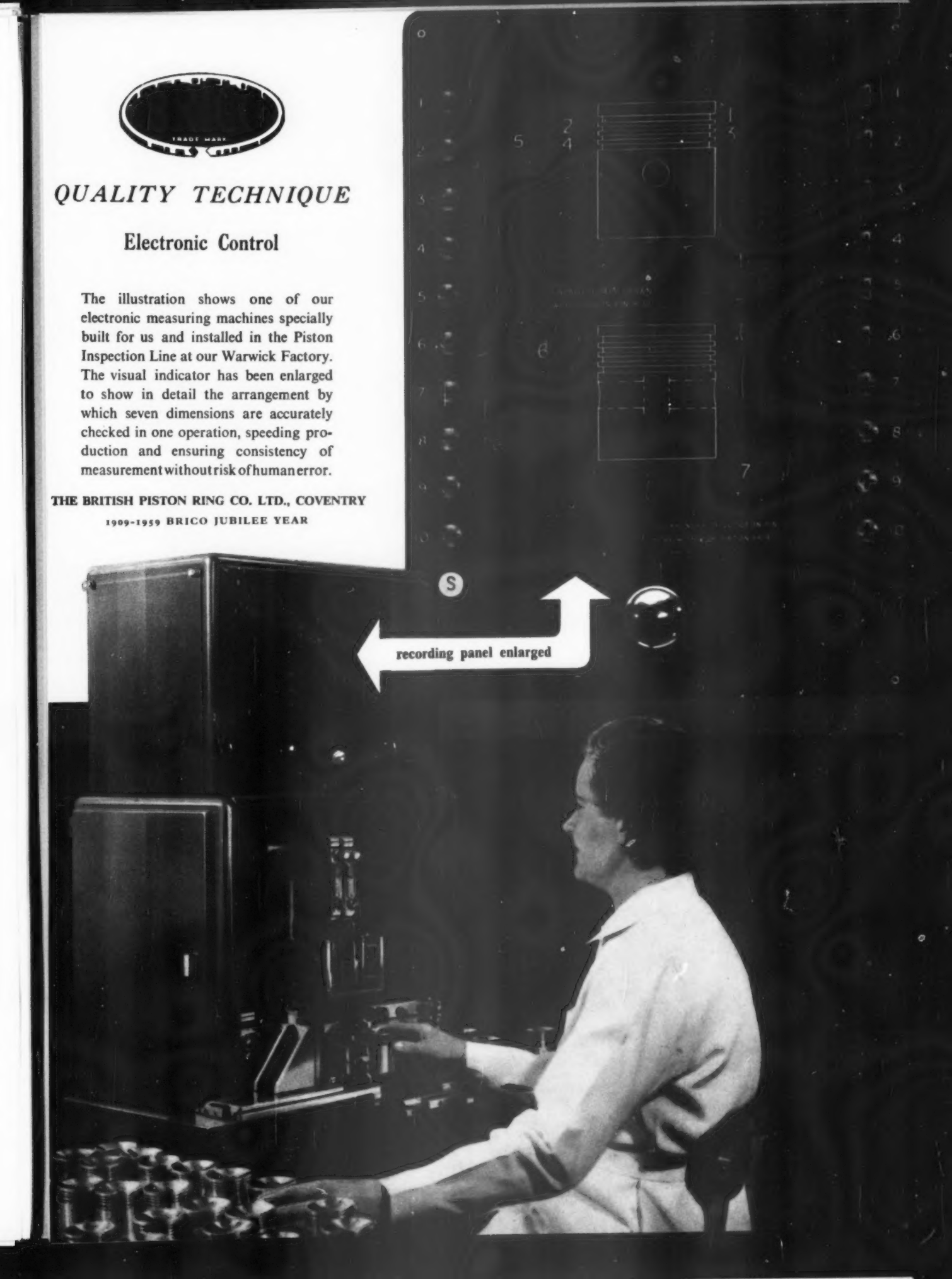
The applications for SALTER springs are wide and varied — from heavy machinery to finely balanced instruments.

By courtesy of Ericsson Telephones Limited.

For springs with the highest reputation and top performance specify SALTER all-action springs.

SALTER ESTABLISHED 1760

GEO. SALTER & CO. LTD
WEST BROMWICH
ENGLAND



QUALITY TECHNIQUE

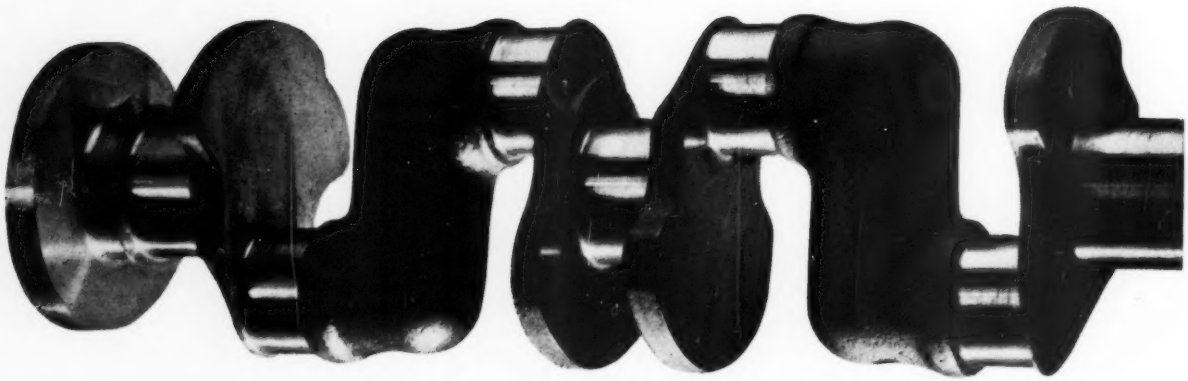
Electronic Control

The illustration shows one of our electronic measuring machines specially built for us and installed in the Piston Inspection Line at our Warwick Factory. The visual indicator has been enlarged to show in detail the arrangement by which seven dimensions are accurately checked in one operation, speeding production and ensuring consistency of measurement without risk of human error.

THE BRITISH PISTON RING CO. LTD., COVENTRY

1909-1959 BRICO JUBILEE YEAR

A new approach to



cast crankshafts in iron

Darcast announce the installation of plant for the quantity production of precision cast crankshafts.

quantity	From tens to thousands per week.
precision	Machining allowances down to as little as 0.030" on journals and crankpins.
material	S.G. (nodular) iron ; min. tensile 35 tons p.s.i. Elongation 2-4%.
service	Prototype to production, from one of Europe's most highly mechanised foundries.

Dartmouth Auto Castings Ltd

Dartmouth Road, Smethwick 40, Staffs

AUTOMOBILE ENGINEER

CONTENTS

NOTEWORTHY FEATURES OF THE NEW B.M.C. CAB ARE ITS REARWARDLY INCLINED DOOR AND THE WINDOW BELOW THE WAIST AT THE FRONT

497 Editorial *Automatic Control of Vehicles*

498 B.M.C. 2-, 3- and 4-ton Trucks *Modified chassis with an entirely new cab design that is of exceptional merit*

501 Controls and Seating *Application of ergonomics, with particular reference to driving control*

504 Pirelli BS3 Tyre *A new development, the basis of which is the use of readily replaceable treads*

506 Bodywork Review *Slight trend away from full unitary construction; changes in styling at front and rear; improvements in respect of trim and insulation of bodies*

517 Cleaning Fuel Injection Nozzles *An automatic machine for continuous operation to clean and dry nozzles*

518 Recent Publications *Brief reviews of current technical books*

519 Exhaust Back Pressure *Its effects on the performance of internal combustion engines* S. E. BONAMY and R. W. UPFOLD

522 Coder Suspension *Ingenious French system for commercial vehicles, embodying rubber elements and giving progressive action*

524 Perkins Six 305 Engine *Six-cylinder power unit, of 5 litres swept volume, intended for commercial vehicles*

526 Automatic Shear Lines *British-built McKay equipment for coiled material of widths up to 72 in*

528 The Cold Working of Steel *Phosphate coatings found to be the sole commercially practicable type of lubricant for severe deformation processes*

531 Deburring Pump Drive Gears *Roto-Finish barrelling operation interposed between hobbing and shaving stations in Vauxhall production line*

533 Automatic Operation of Capstan Lathes *Nickols equipment for the conversion of existing standard machine tools to fully programmed control for small batch production*

Published the second Wednesday in every month by ILIFFE & SONS LIMITED
*Dorset House, Stamford Street, London, S.E.*1
Telephone · Waterloo 3333 (60 *lines*)
Telegrams · Sliderule, Sedist London
*The annual subscription inland and overseas is £*3 0*s* 0*d including the special number*
Canada and U.S.A. $8.50

© ILIFFE & SONS LIMITED, 1959

BRANCH OFFICES
Coventry · 8-10 Corporation Street
Telephone · Coventry 25210
Birmingham · King Edward House, New Street, 2
Telephone · Midland 7191
Manchester · 260 Deansgate, 3
Telephone · Blackfriars 4412 *and Deansgate* 3595
Glasgow · 26B Renfield Street, C2
Telephone · Central 1265

Which timepiece?

An ornamental clock would be no use for timing a runner, and a mariner would soon be lost if he had to get his longitude from an ordinary alarm clock.

The same principle applies to ball and roller bearings. At Skefko we've always stressed the need for the 'right bearing in the right place' and we will go to endless trouble to see that you get it. Of course, as the only British manufacturer of all four basic types we are in a unique position and can offer exactly the right bearing for the job.

SKF

THE SKEFKO BALL BEARING COMPANY LIMITED • LUTON • BEDS.

THE ONLY BRITISH MANUFACTURER OF ALL FOUR BASIC BEARING TYPES: BALL, CYLINDRICAL ROLLER, TAPER ROLLER & SPHERICAL ROLLER

G202

Editor *T. K. Garrett, A.M.I.Mech.E. A.F.R.Ae.S.*
Editorial Staff *F. C. Sheffield (Associate Editor)*
A. Baker, B.Sc., A.M.I.Mech.E.

DESIGN MATERIALS **AUTOMOBILE ENGINEER** PRODUCTION METHODS WORKS EQUIPMENT

Automatic Control of Vehicles

AN unwarranted amount of publicity has already been accorded to accidents on the first long-distance motorway opened in Great Britain: the few that have occurred have been front-page headlines, while many hundreds, and even thousands, of accidents during the same period in the narrow winding roads in the rest of the country have been ignored. Nevertheless, the special conditions obtaining on motorways can call for original thought, and there may be a case for a completely different approach to traffic control, which would lead to innovations in respect of vehicle design. While automation is being applied in ever wider fields, it is logical to investigate the practicability of its application to the control of the steering, acceleration and braking of vehicles. Development along these lines could make possible the operation of vehicles at normal speeds even in the thickest fogs, and could lead to considerable economies in commercial vehicle fleet operation, especially at night.

The widespread adoption of a system of automatic control to reduce drastically the accident rate would also lead to significant benefits in respect of the overall economy of countries. It has been stated by Dr. V. K. Zworykin, in the fourth Maxwell Memorial Lecture, published in the September 1959 *Journal of the British Institution of Radio Engineers*, that the economic loss resulting annually from automobile accidents in the United States is approximately 6,000 million dollars—this sum is comparable with the entire fuel cost for operating the vehicles during the same period.

In his paper, Dr. Zworykin goes on to describe some work that has been done in connection with automatic control of vehicles in America. He also gives figures for fatal accidents on rural roads in that country in 1956. On the road system in general, 40 per cent of these accidents were caused by the vehicles' leaving the road, and 26 per cent by their hitting other cars; in the latter category, only 7 per cent involved collision with the rear end of another car. However, on the turnpike roads, these figures are strikingly different, being 28 per cent, 55 per cent and 40 per cent respectively. It is obvious, therefore, that, in all cases, a marked reduction in the accident rate could be achieved by a system of automatic control to prevent vehicles from leaving the road or from striking another vehicle.

Automatic steering, to keep vehicles in specified lanes, is not too difficult. It can be effected, for instance, by signals from a cable, carrying high frequency current, laid beneath the road surface in the middle of each lane, preferably with a different frequency applied to the cable in each lane. Signals from this cable can be picked up by two antennae, one on each side of the vehicle. So long as the vehicle is centrally disposed above the cable, the signal strengths induced in the antennae will be equal, but if it diverges from its medial path, the signal induced in one antenna will be greater than in the other, and this difference can be passed on either as a visual or audible signal to the driver, or as a control signal to a power assisted steering unit.

Arrangements for collision prevention are inevitably more complex. A system advocated by Dr. Zworykin, which is not necessarily the only practicable solution to the problem, comprises wire loops embedded beneath the surface at intervals along the road. Each loop encloses an area approximately equivalent to the plan area of a vehicle, so the presence of a vehicle above it alters the inductance of the loop. This alteration is detected by an electronic circuit in the highway installation and is transmitted back to successive loops, the amplitude of the signal relayed by each loop decreasing with distance. These signals can be picked up by a detector unit in a following vehicle and, again, they can be transmitted either visually or aurally to the driver or an automatic control system regulating the vehicle's speed. A similar method could be adopted for the prevention of head-on collisions on narrower highways.

Among the advantages of this system is that vehicles equipped with the control can detect any others regardless of whether the other vehicles are similarly equipped. Also, it can be used either for fully automatic control or simply as a method of transmitting signals to the driver so that he can apply human skill and judgment to the application of the appropriate controls. For fully automatic control, the amplitudes of the signals could be regulated to adjust speeds of vehicles on bends, and also the distances between them, to cater for variations in road surface conditions—for example, when the weather is dry or wet—or when snow has fallen. In any case, the driver, of course, should be able to over-ride the automatic control, so that he can apply his knowledge of special conditions, including those pertaining to his own vehicle, which cannot be taken into account by the automatic system.

This is, perhaps, looking a long way into the future, but the problems are such that experimental and development work will have to be put in hand many years before such a system could be realized in practice. That automatic control should be considered seriously is indicated by the fact that rear end collisions are such a high proportion of all accidents on the motorways of the world. In fact, the critical factor that is limiting further progress is the human reaction time, especially when drivers become drowsy.

The cab of the new B.M.C. range has been designed specifically for ease and safety of access, and good all round visibility for manoeuvring in confined spaces under conditions such as might be experienced in door-to-door delivery for the retail trade

B.M.C. 2- 3- and 4-ton Trucks

Modified Chassis with an Entirely New Cab Design That is of Exceptional Merit

As a result of an increasing demand for delivery of retail commodities from shops to customers, there is a tendency for traders to use vehicles, including trucks, in the medium-weight range instead of the lighter delivery vans. To meet this demand, the British Motor Corporation have introduced their new Series 4 range of Austin and Morris 2-, 3- and 4-ton trucks, which have been specially designed to meet the requirements for short distance local deliveries as well as for long distance transport. The new range replaces the Austin and Morris 2-, 3- and 4-ton forward control vehicles; however, the 2-, 3- and 4-ton normal control range is continued. Although detail improvements in respect of the chassis have been introduced, the outstanding feature of the range is the completely new cab, termed the F.G. model.

This cab design gives a combination of an exceptionally good range of vision and ease and safety of access, which probably has never before been achieved. As can be seen from the accompanying illustrations, the door on each side is fitted behind the wheel arch and, as viewed in plan, is set at an angle relative to the side of the cab: that is, its hinge pillar is mounted some distance in towards the centre of the back panel of the cab.

There are many advantages to this arrangement. One is that the doors, when open, do not project more than about 2 in beyond the side of the body and this means that, when the driver opens his door, he does not obstruct traffic overtaking him. Moreover, since he descends in a direction partly towards the rear, he has automatically a clear view of the traffic approaching from behind, and is therefore unlikely to step into the path of another vehicle. Should the driver wish to reverse with the door open, there is no danger of its being damaged by hitting some obstruction at the side while his attention is directed towards the rear of the vehicle and, so far as garaging is concerned, if there is enough room to get the vehicle in, there is also enough for the driver to get out of his cab.

Among the other advantages of the layout is that, since the height of the entrance steps is not governed by the wheel arch, they are low and, therefore, access to the cab is easy. Since the door hinge pillar is inset relative to the side of the cab, the driver has an exceptionally good view to the rear through the side light of the door. A balanced vertically sliding glass is fitted to the door, and the interior lever for actuating the lock extends upwards from the lower edge of the window frame; thus, the inner panel of the door is completely unobstructed. The exterior handle for the door is recessed in a small dished panel, which can be readily removed for attention to the lock mechanism. Around the entrance there are no projections that might catch and tear clothes.

To aid rearward vision, there is a large back-light to supplement the rearward facing door lights. Forward vision is extremely good by virtue of the employment of a wrap round screen with relatively slender pillars. Immediately behind each pillar is a side light, which incorporates a glass

Noteworthy features of the interior of the cab are the grouping of the instruments on an accessible panel above the steering column and the positioning of the electrical switches, ready to hand, on the facia rail, by the driver's right hand

ventilation panel in its rear portion. Dual self-parking windscreen wipers are installed. A noteworthy feature is the introduction of an additional glass panel in each front quarter immediately below the dash facia rail. These panels are low enough to give the driver a good view of the kerb: this is particularly useful not only in foggy conditions but also when parking; as a result, it should reduce the danger of damage to the side walls of tyres as a result of their being driven forcibly against high kerbs. Another obvious advantage is that it greatly reduces the risk of accidents due to tiny children playing in front of the vehicle, in the area that would otherwise be outside the range of vision of the driver. However, these windows in the front quarters can be replaced by steel panels, as an optional extra.

The driver's seat is of tubular construction, with a foam rubber cushion and a back-rest of rubberized hair. It is adjustable vertically as well as for fore-and-aft position. A neat instrument panel is mounted above the steering column. Except for the main headlamp beam control switch, which is on the steering column, all the lighting controls are on the right-hand side, where they can be easily reached by the driver. This layout has been made practicable by virtue of the fact that the facia panel is extended the full width of the windscreen, from door to door. Provision has been made for the fitting of a radio beneath the electric switches, and the speaker can be installed behind the instrument panel. There is a pocket for delivery books and other documents beneath the facia rail on each side of the vehicle. The windscreen wiper mechanism is installed behind a panel on the head rail. This panel, which also carries the roof lamp, is readily removable.

Several improvements have been made to the truck body. Because of the introduction of 16 in wheels on the 2- and 3-ton models, it has been possible to obtain lower platform heights of $37\frac{1}{2}$ in and $38\frac{1}{2}$ in respectively. All vehicles of this range can be purchased with either drop sides or a platform body; they are also available with only the front portion of the cab, up to the door shut pillars, for van conversions. The interior dimensions of the 404 body floor are quoted as 14 ft $3\frac{5}{16}$ in long by 6 ft 8 in wide, the length being quoted from the rearmost portion of the front end, which is angled to clear the cab door when it is opened. For the 304 body, these dimensions are 12 ft 4 in by 6 ft 8 in, and for the 200 they are 10 ft $4\frac{7}{8}$ in by 6 ft 8 in.

Improvements to the chassis include the provision of servo brakes as standard equipment, and the brake lining area has also been increased. The frame members and the rear axles have been strengthened. All three vehicles are available with either a petrol or a diesel engine, which can

When the door of the cab is open, it does not project more than about 2 in outboard of the side of the body, and the door frame and inner trim panel are completely free of obstructions that might catch and tear the driver's clothes as he descends

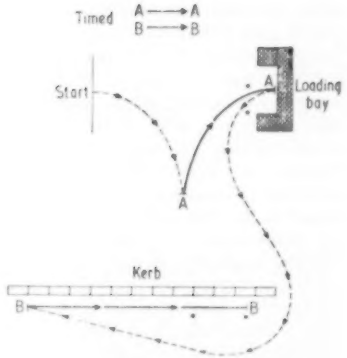
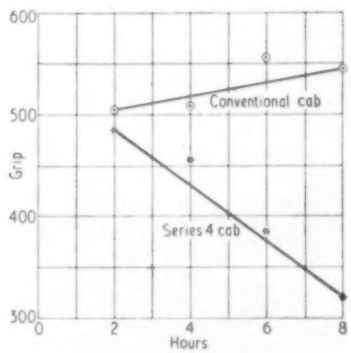


Diagram showing the procedure adopted for the manoeuvrability tests. The reversing operations indicated by the full lines A-A and B-B are those that were timed

be withdrawn forwards, for servicing, after the bolted-on front cross member of the frame and a readily detachable panel on the cab have been removed.

The wheel equipment of the new range of vehicles is as follows. All three have steel disc type wheels fitted with 6-stud fixing, mounted singly on each side at the front and as twin assemblies at the rear. The tyres fitted on the 200 models are 6.50 - 16, 8-ply tubeless type. For the 304 vehicles, 7.50 - 16, 8-ply Highway tyres are fitted for the home market, but for the export market 10-ply tyres of the same size and type are employed. On the 404 versions, 7.00 - 20, 10-ply Highway tyres are fitted for the home market, and 7.00 - 20, 10-ply Roadster tyres are used for the vehicles that are exported.

To assess what advantages the redesigned cab has relative



This diagram shows the results obtained from an interesting method of measuring driver fatigue. Increase of fatigue is said to be indicated by strengthening of the grip on the wheel by the driver

to the conventional design of forward control cab, a series of tests was carried out by a research team under the leadership of Prof. D. C. Drew, M.A., of the University of London. The first of these tests was a comparison of the energy expended by the driver entering and leaving the different types of cab. For the purpose of making the comparison, the amount of oxygen consumed by the driver in breathing, while performing these operations, was measured. It was found that the energy required for entering and leaving a conventional cab is nearly three times that for the new one. Apparently, the earlier type of cab, in which the driver has to clamber over the wheel, is especially hard on older and also on heavier drivers, regardless of their age.

Another test was to compare the relative manoeuvrability of vehicles fitted with the two different types of cab. The first stage of this test was to reverse the vehicle between two posts, placed 2 ft further apart than the vehicle's width, and thence up to a loading bay. This task was roughly equivalent in difficulty to reversing alongside another vehicle, with 2 ft clearance on the width. The second stage was to reverse alongside a kerb to a station between two posts,

each of which was placed a distance, equal to the vehicle's width plus 2 ft, away from the kerb. For these tests the vehicle started with its front wheels on a line, facing the loading bay. It had to be driven forwards while at the same time turning to the right, and then stop and reverse into the bay. After that, it was driven out on a path of approximately S-shape to a point alongside the kerb. Finally, it was reversed to the station, further back, adjacent to the kerb. The criterion of manoeuvrability was taken to be the time needed to perform the whole series of manoeuvres. It was found that with the older cab, drivers improved greatly with practice, but not with the new cab. Also, the final performance with the new cab is better than that obtained after practice with a conventional cab. From these findings, it was concluded that the improved visibility from the new cab makes the task much easier.

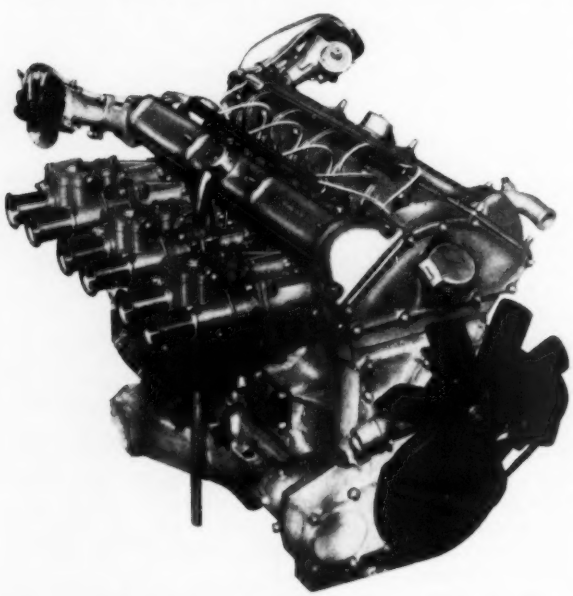
The third test was to assess the differences in driver fatigue by the end of an average working day. It has been found that, as an operator becomes fatigued, he tends to exert greater efforts in making his movements. From this it was concluded that an indication of fatigue might be obtained by measuring the change in the strength of the drivers' grip on the steering wheel. With a conventional cab, the grip was found to rise slightly with time, but with the Series 4 cab, the drivers appeared to relax as the day progressed. Possibly, the initial high level of grip in the new cab was due to the transfer of drivers to it after a long acquaintance with the earlier, more conventional cab.

PRINCIPAL DIMENSIONS OF THE B.M.C. 200, 304 AND 404 TRUCKS

	200	304	404
	ft in	*ft in*	*ft in*
Wheelbase	9 6	12 1	12 1
Overall length	16 8	18 7 1/16	20 7 1/16
Overall height, laden, to top of cab	7 1	7 2 1/4	7 3 1/4
Body interior length	10 4 1/4	12 4	14 3 1/16
Height of body sides	1 6	1 6	1 6
Height of body floor, laden	3 1 1/4	3 2 1/16	3 6 1/4
Centre of rear hub to end of frame	3 6	3 6	4 8 1/4
Centre of front hub to bumper	2 10 7/16	2 10 7/16	2 10 7/16
Centre of rear hub to end of body	4 3 5/16	3 7 1/8	5 7 1/8
Centre of rear hub to back of cab	6 8	9 3	9 3
Maximum length behind cab	11 5	15 3 1/8	15 3 1/8
Body maximum interior width	6 8	6 8	6 8
Cab interior width at waist	5 4 1/2	5 4 1/2	5 4 1/2
Overall width of vehicle	7 0 1/2	7 0 1/2	7 0 1/2
Track, front	5 1 3/8	5 6 1/2	5 7
Track, rear	5 3 1/4	5 3 1/4	5 5 1/2
Turning circle	42 6	47 0	47 0
Ground clearance	7 1/2	8	7 1/2
Weight, approximate			
Petrol	1 ton 19 1/2 cwt	2 ton 6 1/2 cwt	2 ton 7 1/2 cwt
Diesel	2 ton 1 1/2 cwt	2 ton 9 cwt	2 ton 10 cwt

Aston Martin DB4 G.T. Engine

ONE OF the outstanding engines at the 1958 London Motor Show was the Aston Martin DB4 six-cylinder unit, of 3,670 cm^3 swept volume. A higher-performance version of this already very powerful engine has now been introduced, and is fitted to the DB4 G.T. car. The company's racing experience is responsible for a number of features on both.



The new Aston Martin unit has dual ignition and three Weber carburettors

No change has been made to the bore and stroke measurements, which are equal, at 92 mm. In fact, most of the modifications are to the upper portion of the engine. The compression ratio has been raised from 8·2:1 to 9:1, and there are two sparking plugs per cylinder instead of one. Each set of plugs is served by one of the two distributors, which are driven by spiral gears from the rear of the two overhead camshafts. Three Weber twin-choke carburettors replace the two S.U. instruments of the standard engine. Other alterations include improvements to the lubrication system, and the adoption of higher-lift camshafts.

Both versions of the engine have a light-alloy cylinder head and crankcase-block casting, with wet liners. The crankshaft runs in seven bearings, and the camshaft drive is by chain, in two stages. Following normal practice with this type of engine, the combustion chambers are of part-spherical type; the included angle between the valves is 80 deg.

A gross power output of 331 b.h.p. at 6,000 r.p.m. is claimed for the G.T. engine, and its maximum torque is 270 lb-ft at 5,000 r.p.m. This torque is equivalent to the very high b.m.e.p. of 182 lb/in^2. For the standard engine, the corresponding power, torque and b.m.e.p. figures are stated by the manufacturers to be 263 b.h.p. at 5,700 r.p.m., 240 lb-ft at 4,250 r.p.m. and 162 lb/in^2.

N.R.D.C. Bulletin

ISSUE number 15 of the *N.R.D.C. Bulletin* is now available from the National Research Development Corporation, 1 Tilney Street, London, W.1. It contains technical information on silicon nitride, a new high-temperature material, together with brief details of a number of inventions that are available for use under licence. Among them are several of a mechanical engineering nature.

Silicones News

IN VIEW of the greatly increasing use of silicone products in many industries, Midland Silicones Ltd. have introduced a regular news sheet entitled "Midland SILICONE News". It will initially appear bi-monthly and covers interesting applications of silicones, which may be of value to potential users of these materials. Request to be placed on the mailing list should be sent to the publicity department of Midland Silicones Ltd., 68 Knightsbridge, London, S.W.1.

CONTROLS AND SEATING

Application of Ergonomics, with Particular Reference to Driving Control

STANDARDIZATION of vehicle control positions and dimensions, based upon ergonomic principles, seems a logical objective. Many important advantages would be gained: accidents would be fewer, by virtue of the elimination of those caused by the operation of the wrong controls in vehicles strange to drivers; more comfort would be offered to a larger percentage of the motoring public and fatigue would be reduced, because control and seat positions would be based upon human size ranges obtained from statistical measurements. Manufacturers would also benefit from the lower cost of standardized parts designed with more detailed consideration of their purposes.

But there are many practical considerations that prevent standardization and some of the difficulties are as follows. Pedal heights are determined by pedal travel and pressures and until these are standardized by manufacturers, common positions cannot be established. Also, while economic considerations limit the size of the British family saloon car, it is not always possible, theoretically, to accommodate the ergonomist's range of sizes with equal comfort. Nevertheless, adjustments can be extended and critical distances preserved so that inconvenience to tall drivers can be reduced. Given sufficient ergonomic data, a designer could determine what range of sizes would be accommodated in any new design and where he needs to give special consideration for tall drivers.

Further difficulties arise in attempting to provide equal comfort within the chosen range. Theoretically, an appreciable number of adjustments would be required that have not been found necessary in practice. Although more adjustments can be of considerable benefit, it still has to be left to practice to determine how far such adjustments are worthwhile.

All these difficulties must be overcome before general standardization can be expected. An alternative course to the establishment of tentative standards would be the publication of the ergonomic principles and the human size ranges upon which such standards would be based. Vehicle designers could be guided by these so that more conformity would result, until common standardization became feasible.

Unfortunately, the ergonomic data so far made available are not in the form that can be used conveniently by designers. The aim of this article, therefore, is at discussing the main ergonomic considerations and at suggesting the type of data that would enable designers to make practical applications, particularly in the accommodation of variations in human sizes within a chosen range.

It is encouraging to realize that the problem is mainly a mechanical one. In fitting the machine to the man, the driver can be considered as a system of powered levers. Control movement can be arranged to suit the directions in which such levers can exert effort most efficiently and loads can be kept safely within the power they are able to exert. The static function of a seat may also be defined adequately in mechanical terms. It is to support the occupant in the appropriate posture and in a condition of stable equilibrium, by exerting forces equal and opposite to the loads imposed by the weight of the occupant. Given sufficient information of the mechanics of the human body, the automobile engineer should not meet any insurmountable difficulties in providing the equal and opposite forces, for the required equilibrium, and arranging his controls for the most efficient operation.

The problem may be conveniently divided under the headings of pedals, seats, steering and hand controls. While the need for better positioning and more ready identification of hand controls is recognized, other design considerations make it difficult to meet. Discussion under this heading, therefore, would have to be more upon the best possible means of overcoming these difficulties than the ergonomic considerations. This part of the problem is, therefore, not included in this article.

Adjustments

Fore-and-aft seat adjustment is common practice. The value of vertical adjustment as a selling point has surely been underestimated in this country. Many sales must have been lost because short people have not been able to obtain the field of vision and reach of controls they expected. While these adjustments are highly desirable, it is also essential that sufficient strength is maintained in the construction of the seat to withstand back-end crashes. The provision of sufficient strength of the seat to meet the requirements in respect of safety harness is not likely to be practicable, and direct attachment of the harness to the floor appears to be the only reliable form of anchorage.

With a steering wheel inclined about 45 deg, column adjustment should be adequate for both planes. This form of adjustment has often been adopted on the more expensive cars; but, for the cheaper cars, its value has never been considered to be sufficient to justify the extra expense involved. In theory, pedal heights, travels and angles need to be adjustable to accommodate the differences in leg angles caused by seat adjustments, but no such accommodation is likely to prove worthwhile in practice, particularly if the angles and direction of travel are carefully determined before adoption.

Basic data

The positioning of all controls is determined relative to the eye-level and the heel of the foot that is actuating the accelerator. Both the steering column and the seat should lie on a common centre-line, as viewed in plan. Additional shoulder room can be gained by some toe-in relative to the longitudinal centre-line of the car, but excessive side-lurching of the occupant in the seat occurs unless bucket seats are used. The brake and clutch pedals should be equidistant each side of the centre-line of the driver's seat. Both the accelerator and the rested foot should also be equidistant from the same line, and the heel positions on a line normal to it.

Clutch and brake pedals

The line of thrust for the operation of the clutch and brake pedals runs from the hip joint to the ball of the foot. If the line of pedal travel does not lie on this line, there is a component force tending to cause the foot to slip off the pedal. It is also likely that a comfortable angle for the foot will not be normal to the line of thrust. Any deviations should, therefore, be made to favour the foot's slipping

downwards. Murrell[1] states that maximum force can be applied when the leg is not quite straight; that is, when the knee is bent at about 165 deg. He also shows how the force decreases as the angle is reduced below 135 deg.

The amount of clearance below the knee, with a well-shaped cushion, is small, particularly on a high seat. If the pedal travel is long there is a risk of pressure from the cushion restricting the pedal effort at the position where the maximum is wanted. Corpulent drivers may find the operation uncomfortable and the thigh may foul the bottom edge of the steering wheel. In the interests of general comfort and ease of application of effort, clutch and brake pedals should be kept short.

Zero-travel controls are under development, and these systems would appear to provide a remedy. Practice may prove, however, that some appreciable amount of travel is necessary in which to feel the progression of the effort being applied. The limits of pedal pressures require to be a compromise between lightness and feel for both strong and weak legs. Effort beyond the desirable maximum should be provided by means other than the driver's muscles. It is evident that research to determine the optimum pressure and travel distance is required before any standards can be established.

Accelerator pedal

The organ type of pedal is best for accommodating all lengths of footwear. Its height should be at least equal to the distance from the back of the heel to the ball of the largest shoe—a small lady's shoe can be half this distance! The pedal should be hinged at the base and its covering extended along the floor so that the heel rests on it without relative movement occurring between the pedal and the shoe when the pedal is operated. It should be splayed out to suit the natural angle of the foot and its face should be normal to the centre-line of the leg. It is well-known that the ankle is sensitive to tilting movement, and Lehmann[2] considers that an angle of 20 deg for full travel is sufficient.

1 *seat to hip joint;* **2** *seat to head axis;* **3** *eye point above head axis;* **4** *seat to top of head;* **5** *trunk line to back of hips;* **6** *trunk line to back of shoulders;* **7** *seat to deepest point of shoulders;* **8** *trunk line to back of head;* **9** *eye point forward of head axis;* **10** *trunk line to front, at head axis level;* **11** *trunk line to front, at hip level;* **12** *hip joint to knee joint;* **13** *knee joint to ankle;* **14** *ankle to bottom of shoe;* **15** *back of heel to ankle-knee line;* **16** *back of heel to ball of foot;* **17** *length of shoe;* **18** *knee to top of lower leg;* **19** *knee to top of thigh;* **20** *hip joint to top of thigh;* **21** *hip joint to back of knee;* **22** *seat to shoulder joint;* **23** *trunk line to shoulder joint;* **24** *shoulder joint to elbow;* **25** *elbow to wrist;* **26** *wrist to inside of grip;* **27** *elbow to underside of lower arm*

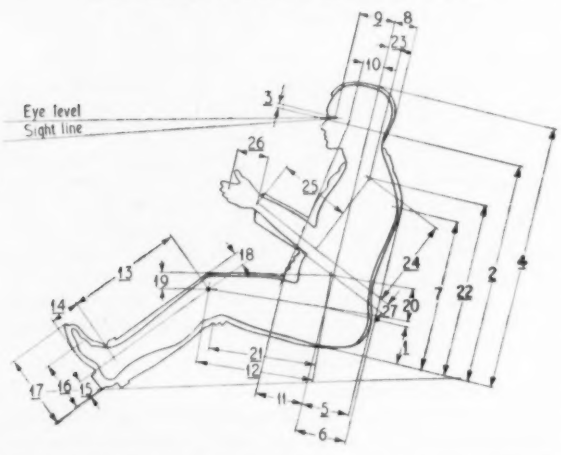


Fig. 1. These dimensions of the human frame are necessary for the determination of a satisfactory layout for the seat and controls. The basic measurements are those underlined in this illustration. In addition to the dimensions shown, the following also are needed: overall height, and widths over hips, elbows, shoulders and shoe at the ball of the foot

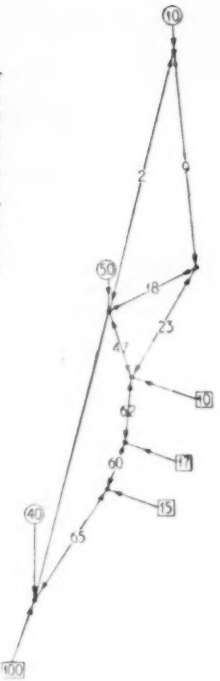


Fig. 2. Diagram showing the application of the principles of mechanics to determine the forces at different points on the human frame. In this particular instance, the trunk angle is assumed to be 15 deg from the vertical. The figures on the lines are the forces in the body, those in the balloons are the body weights at the points of application indicated, while those in the boxes are the supporting forces, or reactions, applied by the seat and squab

The progression in relation to the opening of the throttle is, of course, determined by the linkage, but the foot should be at right angles to the lower leg when the throttle is closed.

Many pedals are set too steeply, so that the driver tends to draw his heel away from the base of the pedal and thus a small amount of leg room is lost. There should be sufficient initial tension on the return spring to carry the weight of the foot without pedal movement. Again, work needs to be done to determine optimum pressures.

As already stated, the rested foot position should be symmetrical relative to the accelerator foot position and a similar pedal for actuation of the dimmer switch would provide a well-balanced posture and a firm base against which the driver can push himself well back into the seat for maximum support.

Steering wheel

An inch or two of car length is often wasted by incorrect positioning of the steering wheel. A column longer than optimum causes the seat to be pushed back further than necessary for a comfortable leg posture. The most comfortable position of the steering in relation to the rest of the seating is difficult to specify, but Lehmann[2] recommends an included angle of 87 deg at the elbow. He also states that the largest force can be exerted on an almost horizontal wheel, but the greatest velocity can be applied to a wheel that is nearly vertical. Only an adjustable steering column and a four-way seat adjustment can provide the same comfortable arm posture to all sizes of driver.

Seat cushion, squab and armrests

Contrary to popular belief, support is not required under the knee. The weight of the leg is adequately carried on the hip joint at one end and on the floor at the other. Support, however, is necessary forward of the haunch bones to cradle the pelvis between the cushion and the squab and to resist the component force created by the sloping trunk line which tends to slide the body forward in the seat.

As already stated, the line of leg thrust in pedal operation runs from the ball of the foot to the hip. Resistance to

this force is provided by the squab, at a point lying on the extended line of thrust. In the case of a seat the height of which is such that the hip joint is above the ball of the foot, there is a component force tending to lift the driver off the cushion, so the squab should be shaped to resist this.

The weight of the upper trunk can only be supported by the squab when the trunk angle is large enough to bring the centre of gravity behind the hingeing lumbar joints. Such an angle would not be appropriate to the alert posture required for driving and would, surely, cause neck ache. The minimum angle, between the trunk axis and the eyeline, to avoid this would be a most valuable piece of information for the guidance of designers. Obviously the upper part of the squab should be shaped away from the shoulders, to avoid interference with their movement, but close enough to resist acceleration.

A critical feature is the position of a driver's armrest. The weight of the arm is carried by the shoulder at one end and by the wheel rim at the other. Obviously a rest cannot be fitted to support the arm when the hands are at the ten minutes to two position on the wheel, and with the hands in the twenty minutes to four position, it could carry only a small part of the arm's weight without interfering with wheel operation and would require very critical adjustment. Armrests for drivers, therefore, are difficult to justify.

Measurement of seating

It is unfortunate that a method widely adopted for the presentation of seating measurements to the public tends to discourage manufacturers from providing maximum fore-and-aft adjustment of the seat. For the measurement of knee-room in the rear seat positions, it is customary to put the front seat in its mid-position. A design with ample backward adjustment would, therefore, be described as having less knee-room in the rear than if the adjustment had been curtailed for some reason by the designer of the car.

To overcome this fault it is suggested that the 36½ in dimension from the accelerator pedal to the face of the bottom of the squab, as adopted for visibility tests by M.I.R.A.,[3] should be used.

Ergonomic data

Most of the anthropometrical data available are not in the form in which vehicle designers can make the best practical use of them. The positions and lengths of the various components, as shown in Fig. 1, are required. It is hoped that these can be obtained by calculation from the range of overall heights and other dimensions already known. If standard deviations were also provided for each dimension, the designer could determine the range he is able to accommodate in his available space. Whatever may be the occupied shape shown on the drawing, the actual shape and the pressures exerted over that shape can only be measured in the prototype seat.

The same data, therefore, would also enable a comfortable position to be chosen by a tester and, from his own sizes and the range limits, he could check that the same posture is available over the chosen range.

Fig. 2 illustrates the type of diagram that the designer can make to arrive at the forces to be exerted by the seat when the centres of gravity of the human body are known.

References

1. E. F. H. MURRELL: "Data on Human Performance for Engineering Designers." *Engineering*, Aug. 16, Sept. 6 and Oct. 4, 1957.
2. G. LEHMANN: "Physiological Basis of Tractor Design." *Ergonomics*, Vol. 1, Pt. 3.
3. R. A. C. FOSBERRY AND B. C. MILLS: "Measurements of the Driver's Visibility from Private Cars and Commercial Vehicles and Some Recommendations for Minimum Visibility Requirement." *Motor Industry Research Association*, 1956/1.

Russian Patents

A PUBLICATION entitled *Russian Patents Gazette* has recently been introduced by the Technical Information Co., Chancery House, Chancery Lane, London, W.C.2. It is published fortnightly, and contains abstracts in English of all new Russian patents and invention certificates, arranged under 91 class headings. There are two annual subscription rates, £32 for the complete gazette and £20 for either the general, mechanical and electrical sections or the chemistry and chemical engineering sections.

The company is also able to supply copies and translations of Russian patents. Its *Patents Abstracts Journal* and *German Patents Gazette* will continue to be produced. Further details of all these services can be obtained from the Technical Information Co. at the address given above.

D.S.I.R. News

IT HAS been announced by the Council for Scientific and Industrial Research that the name of the Mechanical Engineering Research Laboratory, East Kilbride, has been changed to the National Engineering Laboratory. The change does not imply any alteration in the laboratory's field of activities, but has been made to emphasize the national character of this branch of the D.S.I.R. In addition, a Steering Committee has been appointed to formulate and guide the programme of the laboratory, which is felt to provide an important research link between the universities and technical colleges, on one hand, and the research associations together with industry in general on the other hand.

The chairman of the new committee is Vice Admiral Sir Frank Mason, K.C.B., M.I.Mech.E., M.I.Mar.E., who is a member of the Research Council and chairman of the outgoing Mechanical Engineering Research Board. One of the four members of the committee is Professor O. A. Saunders, M.A., D.Sc., M.I.Mech.E., who is Professor of Mechanical Engineering at the Imperial College of Science and Technology. The committee is empowered to set up specialist sub-committees as necessary for any particular work being undertaken.

Cast Iron Research

AN EXPERIMENTAL cupola furnace installation and a laboratory for the investigation of foundry atmospheres are two recent additions to the facilities provided by the British Cast Iron Research Association, Bordesley Hall, Alvechurch, Birmingham. The cupola furnace has a diameter of 30 in, is charged mechanically and is fully instrumented. It can be operated as a cold blast unit, or with hot blast, in which case pre-heating of the blast up to 800 deg C is possible.

In the new laboratory, the aim is at improving the working conditions in foundries. Investigation is carried out of the manner in which dust and fumes are produced, and of methods of rendering them harmless to the operators. Several dust sampling instruments are in use, and experimental plant has been installed for the study of dust extraction problems. It is noteworthy that the Association has been responsible for an improved system of dust extraction for pedestal grinders, which has greatly reduced the risk of dust inhalation by the operators of these machines.

PIRELLI BS3 TYRE

A New Development, the Basis of Which is the Use of Readily Replaceable Treads

AN entirely new method of tyre construction has been developed and patented by Pirelli Sp.A., of Italy, which is the rubber and tyre research centre for the Société Internationale Pirelli organization. If the results obtained during the long period of development and testing are realized in normal service, the new tyre represents a significant advance. Basically, this advance has been obtained by the employment of replaceable treads, in the form of three tread bands accurately located and firmly held between four ribs around the outer periphery of the tyre. The spaces between the ribs are in the form of grooves with tapered sides, into which the tread bands wedge tightly, as the casing expands under the influence of the inflation pressure.

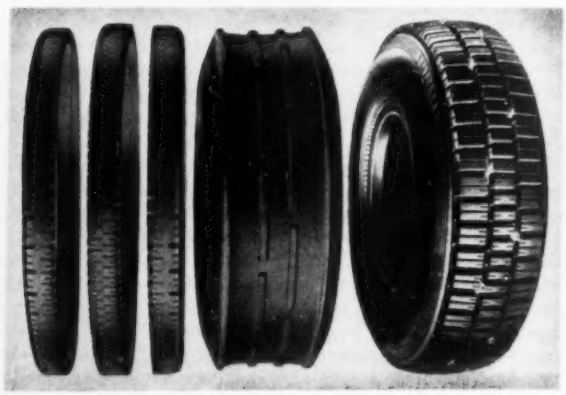
It is of interest to trace the lines of thought that resulted in the development of this tyre and the ways in which the various requirements were met. Pirelli engineers summarized the requirements for a tyre as follows:

1. The highest possible traction and braking efficiency on all types of surface
2. It must give a comfortable ride
3. Silence
4. Long life and low cost per mile of operation
5. It must require a low steering effort
6. Resistance to puncturing.

The requirement in respect of traction and braking efficiency can only be met with a different tread to suit each surface condition, such as mud, snow, ice, and wet or dry tarmac. It is this requirement that really pointed to the employment of separate tread bands that can be easily changed. For ice, it is desirable to use metal spikes, and these, in fact, are available and can be readily fitted to the new tyres.

To ensure that the tread bands are held firmly in position when the casing is inflated, they are reinforced with flexible steel wires and their inner peripheries are slightly smaller in diameter than the casing, between the bases of the ribs. When the casing is deflated, the bands can be readily removed and replaced without the use of special tools. In the relatively unlikely event of a puncture, the tread bands do not become detached until considerable deflation has occurred. The manufacturers claim that the vehicle can travel safely on a partially inflated casing for some distance without the bands. Because the tread bands are interchangeable, it is practicable, in countries with clearly defined seasonal climatic changes, to fit tread bands to suit the prevailing conditions. Owing to the restraint of the steel reinforcement in each band, the sipes of the summer pattern are held rigidly open during the flexing of the tyre, and this affords maximum grip on wet roads, such as may be encountered during the summer and especially in certain tropical countries. This open sipe formation also facilitates the dispersal of heat generated in the rubber.

On the left of this illustration are three standard tread bands, and in the centre is the casing; to the right of this is a complete assembly comprising a casing, a set of three winter tread bands and the ice spikes



The ice spikes, one of which is shown in an accompanying illustration, have tungsten carbide tips, and their bases are flanged and fit in slots in the peripheral ribs of the casing in such a way that the tread bands seat on the flanges and hold them in position. An advantage of this arrangement is that the spikes can be removed when not required. It is claimed that a car equipped with these spikes can be driven with complete safety on ice and that, when an ice-free stretch of road is met, it is possible to drive at unreduced speeds without the unpleasant clatter associated with chains. The manufacturers state that, during tests carried out on an ice rink, it was found possible to apply full pressure to the brake pedal when the vehicle was travelling at 25 m.p.h., and the car could be halted in a straight line in a distance of about 40 ft. Under the same conditions, a similar car equipped with normal tyres spun when the brakes were applied, and could not be stopped within the distance available on the rink. Normally these spikes would be fitted in conjunction with winter treads. These treads have a pattern comprising large solid blocks of rubber, which penetrate soft snow or mud to grip the hard surface beneath.

From the point of view of comfort, the casing has been designed to minimize, so far as is practicable, the resistance to impacts during its passage along the track. In addition, the action of the three completely separate tread bands is such that each readily absorbs the local blows without transmitting these to the other two. It is of interest that these tyres have been found to be particularly sensitive to shock absorber settings. They operate well with dampers that allow relatively free movement initially and then introduce more damping progressively.

The BS3 tyre is quiet during cornering, because it has an extremely flexible casing and also the tread bands, being separate, isolate the local areas of distortion. Moreover, the steel reinforcement prevents moving or shuffling of the sipes, which is one of the causes of tyre squeal. This also helps to increase the life of the treads.

With the BS3 tyre, the coupled effects of an extremely flexible casing and the encircling action of the tread bands is such that a minimum of side-scuffing takes place. This helps to increase the length of life of the bands. Uneven wear of the tread, perhaps as a result of wheel misalignment or incorrect inflation, need not result in premature failure of the tyre, since the bands can be easily changed over from wheel to wheel or from one part of the tread to

another, to even out the wear. As the treads wear they can be replaced either singly or in complete sets, as necessary. The casing will outlast two sets of treads, and probably three complete sets can be used before it becomes due for replacement. In exceptional circumstances, treads can be replaced without even taking the wheel off the car but, in any case, it is never necessary to remove the tyre from the wheel for this operation. In the event of exceptional damage to the casing, that component alone has to be replaced, while the original tread bands can be retained for further use. All these features help in respect of overall length of life and reduction of operating costs.

A marked characteristic of the new tyre is the exceptionally light steering obtained with it. This can be explained mathematically by the characteristics peculiar to the combination of a flexible carcass with a rigid tread. Because the tread bands have to be manufactured to standards of accuracy not normally required in conventional tyres, the dynamic balance of the BS3 tyres, it is claimed, is exceptionally good. Although one hundred per cent puncture resistance is not obtainable with this design, there is no economic incentive for running the tyre bald, which is the condition under which most punctures occur. On the contrary, if the tread bands are replaced as soon as the pattern begins to disappear, the casing can be used again up to mileages not normally obtainable with standard tyres. So far as puncture resistance is concerned, the metallic reinforcement built into the treads helps.

Among the other advantages of the new arrangement is that rolling resistance is less and the power absorption factor reduced relative to that of a conventional tyre. Also, the elements of the tread have a constant contact pressure, whereas in normal tyres this pressure varies across the tread area. By virtue of this feature, adhesion should be improved.

One of the ice spikes, with its tungsten carbide tip. These spikes are fitted, as shown on the extreme right of the illustration on the opposite page, with their bases in the slots in the two intermediate peripheral ribs, which can be seen in the picture of the casing

The price of a complete BS3 tyre, including its three steel reinforced, rubber tread bands, is about the same as that of a normal high performance tyre. Each tread band costs approximately 12 per cent of the total, so the cost of replacement per set of three bands is about 36 per cent of that of a new tyre. Plans for producing the BS3 tyres at the Burton-on-Trent factory of Pirelli Ltd. are well advanced. Initially, a range of tyres will be made available for 15 in wheels, for original equipment or replacement.

Anti-Squeal Brake Lining

Promising New Friction Material Now in Production by Gandy Ltd.

THE phenomenon known as brake squeal, still relatively common, is the result of resonance set up by vibrations occurring when the brakes are applied. Usually, though not always, the resonant component is the drum or the backplate of the brake. Because mechanical means of overcoming the resonance have sometimes proved unsatisfactory, Gandy Ltd. has tackled the problem from the aspect of the lining material.

Since it is necessary that an anti-squeal, moulded lining also has good braking characteristics, the following requirements were initially laid down for the material:

a. A coefficient of friction in excess of 0·3
b. Long working life
c. No deterioration in frictional qualities with rise in temperature
d. Maximum resistance to oil and water.

For the research programme, a number of basic mixes was prepared, each made from a different synthetic polymer. After testing these materials in the laboratory, the best of them was taken as the basis for the second stage of development. Hundreds of variations on this mix were prepared; key mixes were then chosen statistically, and were made and tested. From the results, the series that appeared to have the best combination of properties was made the basis for the next series of mixes. This series was then investigated, and eventually a material was developed that fulfilled all requirements.

The next stage was an intensive test programme on a 3-ton commercial vehicle. During this programme, the conditions were carefully controlled, and improvements suggested were incorporated in the material. Full use was made of the M.I.R.A. facilities at Lindley. For the final, general testing phase, linings were made in the production department for trial on a number of the company's fleet of vehicles. Those used included cars of various sizes and types, a 5-cwt van and several motor-cycles. During the testing period, over 150,000 miles were covered on the road under a wide variety of conditions.

This new lining material, now known as 801A, proved very satisfactory on test. There were no reports of fade or squeal, although certain of the vehicles had been prone to squeal with the original linings. Another feature of the material was that it gave a soft pedal action: the resultant high degree of control over the braking pressure applied was found of great value on ice-bound roads. These characteristics were confirmed subsequently, when small batches of linings, of 801A material, were distributed to selected customers for field experience. As a result of the favourable reports that have been received, the new material has now been released to the factory for full-scale production.

Instrument Research

A NEW research laboratory has been opened within the last few weeks by the Cambridge Instrument Co. Ltd. The building is of modern design and is fully equipped for its purpose. It comprises three sections, one for mechanical engineering, the second for physics and electronics, and the third for physical chemistry. Among the interesting development programmes now in hand is one on taut suspension movements for moving coil instruments. In these, the conventional pivot and jewel bearing arrangement is replaced by short metal bands under tension. By this means, unreliability due to pivot wear, dirt or jewel damage is obviated and a more efficient instrument is the result.

Bodywork Review

Slight Trend Away from Full Unitary Construction; Changes in Styling at Front and Rear; Improvements in Respect of Trim and Insulation of Bodies

The Morris Oxford Series V saloon, styled by Pinin Farina, has restrained decoration, a flat roof and large area of glass

ONE of the outstanding features of the quantity-produced bodywork at the 1959 London Show was the break away from the accepted principles of unitary, or chassisless, construction. These principles require that all panels forming the body assembly shall carry their share of the stresses imposed, the only exceptions being the moving panels, such as the doors, boot lid and bonnet. Now a modified method is being adopted, not only on new models but also as an adaptation to existing saloons. In this new layout, sturdy pressed steel sections are used, both longitudinally and cross braced to the floor unit, in such a manner that they provide what is almost a chassis frame. One manufacturer has reversed the trend of recent years by introducing a car with a separate chassis frame on which is mounted bodywork in which the pressings are not interdependent so far as the ultimate rigidity of the structure is concerned.

While this departure from unitary construction to a separate chassis is evident in the design of certain 1960 British cars, it is interesting to note that some American makers are moving in the opposite direction, abandoning the separate chassis in favour of the unitary structure. Two other points of special interest are apparent: the first is that a new approach has been made to the design of many of the smaller components used in the final assembly, and the second is the increasing use of stainless steel for car body exterior trim. On a number of the latest models, chromium plating has given way to stainless steel for radiator grilles, window frames, windscreen framings and wheel nave plates.

An interesting detail of the Farina styled B.M.C. cars is the use of torsion bars to pre-load the lid of the boot towards the open position

Throughout the range of saloon bodies, there has been a marked increase in the use of a shallow roof pressing. In many cases, this has been accompanied by a reduction in the width of the rear quarter panels, in some cases almost down to mere pillars. Such a complete change in design within the roof area means that additional strength must be given to the body portion below the waist-line in order to maintain torsional rigidity.

New saloon models announced by the British Motor Corporation include the Riley 4/Sixty Eight, which is a Farina styled 1½-litre car. A single unitary basic structure is common to the Austin A55, Morris Oxford, Wolseley 15-60 and M.G. Magnette Mark III and 1½-litre Riley models. Its design gives maximum strength and torsional rigidity coupled with the minimum of weight. The floor and outer panels are 20 s.w.g. pressed steel sheet, each being swaged where necessary to increase the strength and stiffness. Full-length side members are welded to the underside of the floor pressings; these are additional to the door sill sections, which form part of the normal unitary construction.

To ensure the continuity of the box-like structure, the junction of the roof pressing to the cant rails is effected by roller spot welding. This method of assembly has the additional advantage of eliminating any chance of water leakage from the roof edge gutters into the interior of the body. Behind the interior trim panels, the shell is liberally sprayed with a bituminous compound, to reduce drumming and vibration. The whole floor area is similarly treated on the inside, as are the wheel arches, the inner panels of the doors, the scuttle panels and the boot structure, including the lid.

Other new B.M.C. models which have unitary construction as their basis are the two ADO 15 models known as the Austin Seven and Morris Mini-Minor. Much of the primary strength of the bodywork is derived from the forward bulkhead which has to take its share of the loading imposed by the engine and the front-wheel-drive transmission. The ingenious design of this body, together with the placing of all the mechanical parts entirely on two separate sub-frames, makes possible the use of 80 per cent of the total length for passengers and luggage, with the minimum of obstruction

from the mechanism. For instance, the absence of a longitudinal propeller shaft makes possible a low floor line, and in turn a low roof level, while ensuring an adequate roof to floor dimension of 45 in.

An example of the modified unitary construction mentioned earlier is in the Sunbeam Alpine open sports car which, of course, has no integral roof pressing in the body construction. The main floor pressings, together with the side sills, the rear seat pan pressing and the four wheel arches, form a complete sub-assembly; this unit is then strengthened by the attachment of full-length, box-section longitudinal members incorporating central cross bracing. In this way the whole floor sub-assembly becomes a beam. Welded on to it are three other sub-assemblies, one of which is the bulkhead unit, having a pair of braces extending forward over each front wheel arch and tied together at the front by the radiator support panel. Over this is dropped the front exterior panel pressing assembly, comprising the bonnet surround and both front wings. The third sub-assembly, at the rear, consists of the boot decking and the rear wings.

A completely new approach to body design is found in the Triumph Herald, in which unitary construction has been dispensed with, in favour of a separate chassis. This system is, of course, not new, nor is this car the only one on which it is still employed. However, the interest lies in the extreme simplicity of the body design in which two models, a saloon and a fixed-head coupé, use common units with the exception of the roof portions which, of course, are quite different.

This design is worthy of close inspection, since it incorporates a series of pressed steel panels bolted together and also bolted to the chassis frame. The complete body comprises seven units and three main sub-assemblies. One advantage of this method of body construction is that any future styling alterations necessary to meet changing fashions can be easily effected. Ultimately, the same basic chassis could be provided with a wide variety of simple body constructions, changes in styling being made at a much lower cost than that involved with unitary construction.

Such a design permits the various sub-assemblies to be contracted out to a number of firms that would be unable to undertake the quantity production of an all-welded body. In addition, there is no need for complicated and expensive assembly jigs, fixtures or spot welding equipment. The repair and replacement of body parts, too, becomes a simple and relatively inexpensive matter, since damage done to one part of the body will not directly affect the structure as a whole.

Although the number of sports saloons of the *gran turismo* type is increasing, there is a wide divergence in the design treatment of the rear end. In the latest DB4 G.T. Aston Martin, the long sweeping roof line is blended, as viewed in plan, rather sharply into the large boot lid. On the other hand, the sweeping line of one body on a Bristol chassis continues the roof well to the back of the body. The stumpy tail falls sharply away, and is so constructed that the boot lid assembly includes the large rear window. A similar styling approach is evident in the body design of the Peerless G.T. saloon, but in this case the roof drops at a more reasonable angle and is supported by a rather short boot; in consequence, the boot lid is small. The Zagato bodied Bristol 406 is representative of another form of treatment, which in this case starts with a very square roof line at the rear, supported by a flat rear window glass, and then joins the boot decking in a similar manner to that used in normal saloon body styling.

In their styling, many of the new models show a remarkable originality of thought, and reveal evidence of a more subtle approach by the manufacturers. One example of the improved outlook is the 1960 Ford Anglia, which is unusually styled in respect of the reverse rake of the rear window glass. This design provides additional headroom for the occupants of the rear seat, and also an increase in their legroom. In profile, the Anglia, the Triumph Herald saloon and the Fiat 1800 all have a square-back styling and, in consequence, have that very desirable feature of more space in the rear than can be obtained with bodies of similar size but with a curved roof line.

Turning now to the front end, the general trend on the new models is to reduce the height of the bonnet nose. This feature is pronounced in the new Hillman Minx, the wide air intake grille of which is divided in the middle by a series of short, horizontal bars. Other examples of the low frontal line are the Sunbeam Alpine, the Lotus Elite, the well streamlined Alfa Romeo Giulietta Sprint Speciale and the A.C. Greyhound. In general, the frontal grilles of British cars have remained restrained and, in many cases, dignified in their styling. Either they take the form of a series of horizontal or vertical bars, or else they are stylized versions of the original radiator form, as in the case of the Wolseley, Riley and M.G. and, in the higher price range, Bentley, Daimler, Rolls-Royce, Armstrong Siddeley and Mercedes-Benz cars.

The dispersal of rain water from a body is always a source of some uncertainty, particularly as many bonnet and boot lids are confined entirely to the top surface area of the body. In the case of the Morris Oxford Series V, the bonnet fits over a deep metal channel that surrounds the engine compartment. This channel leads any water settling on the bonnet away from the mechanical parts. For this purpose, the Wolseley 6/99 has a shaped channel round the engine compartment, but this channel is blocked at four

From the styling viewpoint, one of the most unusual of the new quantity-produced cars is the Ford Anglia. The flat rear light has a reverse rake, a feature that gives maximum headroom, and protection from the sun, to the occupants of the rear seat

Left: The Zagato bodied Bristol 406 has inset headlamps, and the air intake is incorporated in the bonnet lid. A slight crank is given to the side mouldings

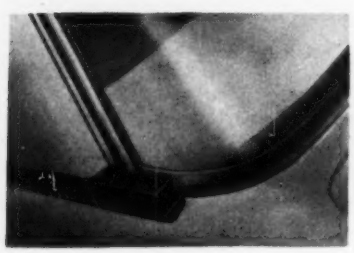
Below: A shallow channel is formed in the flat roof of the Zagato Bristol, and the large rear light is flat and well raked

points by the wedge shape rubber blocks on which the bonnet lid sits when closed. The boots of these Farina styled B.M.C. saloon bodies have a large area opening involving not only the upper surfaces but also the rear panel; therefore, the whole of the opening edge is formed into a channel to bring down water from the rear decking to the base of the rear end of the body.

On the 1960 Panhard PL 17, the boot has been restyled to provide a marked horizontal curve round the whole of the rear end, and the middle portion of the back panel forms part of the boot lid. The swan-neck hinges of the lid are supported by a pair of spring-loaded telescopic struts positioned underneath each hinge and at an angle to the floor. This mechanism permits the heavy boot lid to be lifted easily, and retained in the open position. The periphery of the boot opening is covered with a strip of thick sponge rubber, to prevent water or exhaust gas blowing into the boot.

On smaller cars, having a relatively flat roof area, such as the Austin Seven and the Morris Mini-Minor, the problem of the disposal of rain water is rather specialized. The two cars mentioned have a continuous water channel completely round the roof, and it is provided with drain holes at the rear corners. To ensure that rain is not blown into the car interior through the door hinge joint at the windscreen pillar, a water channel extends obliquely downwards on each side, in an almost straight line, from the roof gutter to the edge of the front wheel opening. A balanced appearance is given by similar channels at the rear, running down the rear corner pillar to the bottom of the body. On these models, it is noticeable that the wide grille exposes the front of the transverse engine to driving rain: no provision is made to shield the coil, plugs and distributor, all of which are in front of the engine. Nevertheless, no trouble seems to be experienced as a result of moisture finding its way into the ignition equipment.

In such a wide range of bodywork, designed on a variety of principles, it is to be expected that changes have been made in the smaller fittings and hardware. For example,



On the Fiat 1800 car, the bright side-strips are blended into the rear light surround by the neat housings for the twin rear parking lamps

on the B.M.C. range of Farina styled cars spring balancing of the boot hinges is effected by a pair of torsion bars, transversely disposed underneath the boot decking. On one end of each bar is fitted a roller that runs on a curved slide attached to the boot lid, in such a manner that the lid is held in the open position by the loading of the bars in torsion.

An instance of the use of special fittings to hold doors open is found on the 1960 Renault Dauphine. A spring-loaded fixture is mounted on the A-pillar, between the door hinges, and is swivel-connected to the door: when the door is opened, this spring comes into action and holds it in that position. The problem is tackled in another manner on the Plymouth Fury convertible, in which a flat torsion bar, mounted vertically between the hinges, assists in the operation of the heavy door. Certain Chrysler models have a spring-loaded rod built into the upper hinge: when the door is opened, this rod enters a groove in a plate moving with the door, to act as a sprag. A sharp pull on the door expands the spring so that the rod is forced out of the groove, and the door is then closed against the decreasing pressure of the spring.

Particular attention has recently been given to preventing the accidental opening of doors by children playing with the handles. The rear doors of the Vauxhall Victor have handles that, when locked, become inoperative although the locking plungers still function. To bring the handles into operation, it is first necessary to lift the plungers, although this action by itself does not open the door lock. The B.M.C., Farina styled new cars have rear door-lock units each equipped with a separate lever which, when the door is shut, is completely

enclosed between it and its pillar, and which, when operated, prevents the door from being opened from the inside.

Items of interest inside the new cars include the replacement of stiff sun visors by the flexible type, as on the Triumph Herald de luxe model, and the increased fitting of ash trays of adequate capacity. The positioning of these ash trays varies, but in the Jaguar Mark 2, a large tray is fitted in front of and between the two front seats, within easy reach of both occupants. On many models, the fastening of the front ventilating panels has been repositioned in relation to the hinge line. The changed position makes it necessary to pull this fastener toward the rear of the car, to open the panel, and not to push it forward, as was the case with the previous arrangement. Since this new action is virtually impossible to perform from the outside, unlawful entry is made more difficult.

The interior trim and furnishing of British cars is becoming increasingly distinctive in appearance and practical in application. New materials are being used to provide additional comfort for the occupants. Figured wood is now more widely used for facia panels and door cappings than at any time in the post-war years, while leather is now applied either fully or partially to seat cushions and squabs on a large number of models. The 1960 Humber Super Snipe saloon is an example of high-quality interior finishing: burr walnut panels are employed for the facia and the wide door cappings, and the upholstery is of leather. A similar specification is applied to the new version of the Wolseley 6/99.

Another feature, of a thoroughly practical nature, is the increasing use of parts of the body interior to accommodate maps, papers and small parcels, the actual method varying with each model. In the new Austin Seven and Morris Mini-Minor, the provision of ample stowage space is facilitated by the absence of interior trim panels on the doors and rear quarters. The door construction permits very

The latest B.M.C. cars have Wilmot-Breeden Zero-torque locks. On these, a safety catch is fitted, operation of which renders opening possible only from the outside of the vehicle

roomy pockets in the lower part of each door, and there are additional pockets in the sides, alongside the rear seat. In the Jaguar Mark 2, soft pockets are provided in the forward portion of each rear door, these pockets just clearing the heel board when the door is shut. Repositioning of the spare wheel on the MGA 1600 has resulted in an unobstructed space behind the front seats, so permitting the stowage of large suitcases. Practical use has been made of the gap between the separate front seats of the Sunbeam Alpine, by installing a deep, fixed armrest, the top of which opens to give access to a surprisingly large parcel space.

Shock absorbent pads and rolls applied to certain parts of the interior are a feature of a number of cars. Two unusual applications are found on the Armstrong Siddeley Star Sapphire limousine, in which safety rolls are fitted underneath the burr walnut window fillets of the rear quarters, and also underneath the cappings of the rear doors. The fitting of the rolls is neatly effected.

On the Riley 4/Sixty Eight saloon, a padded roll is fitted along the top of the facia panel, while another covers the edge of the full-width parcel shelf beneath the panel. A similar roll is fitted to the parcel shelf on the Wolseley 6/99 and extends round the corner of the shelf to finish at the A-pillars. Beneath the sloping windscreen of the Rover models 80 and 100, a leather covered roll is provided above the facia panel; this cover serves the additional purpose of reducing reflections at night.

The siting of important instruments directly ahead of the steering wheel is becoming increasingly popular. On the new Ford Anglia, for example, the instruments are carried in a separate panel, which is let into the main facia panel and is tilted at a slight angle for ease of reading through the two-spoke wheel. A distinctive feature of the Riley 4/Sixty Eight model is the grouping of the instruments in a separate housing let into the top of the facia panel and projecting above it.

A field in which there is ample scope for variety is the styling of interior trim and seating, particularly now that the range of both natural and synthetic materials is so large. The sedate styling applied to the Morris Oxford Series V

Above: To give rigidity, the front of the plastics body of the Citroën Bijou has a relatively sharp, horizontal edge; the headlamp mountings are set into the wings

Right: Another plastics body is that of the Daimler SP250 sports car. The swagings round the wheel openings, and the domed bonnet lid, increase the panel stiffness

saloon embodies a series of simple pleats on the seating, with a wide roll on the forward end of each cushion to provide support for the thighs. Beneath this upholstery, however, resilient webbing forms the basis of the seat construction. It is applied in such a manner that the seat becomes a hammock: the strips of webbing form a continuous series and are set at a predetermined tension. They are clipped to the tubular steel frame at the top of the squab, then pass through a wire clip at the bottom, and extend forward to another clip at the front of the seat. These main strips are interlaced with lateral strips on the seat and part way up the squab. Foam rubber is used as a filler material for the cushion, and rubberized hair for the squab, these filler panels being placed directly on the webbing. This method permits the webbing to move, to balance the pressures on the seat and squab; thus, the seat adjusts itself to the loading imposed by the individual passenger.

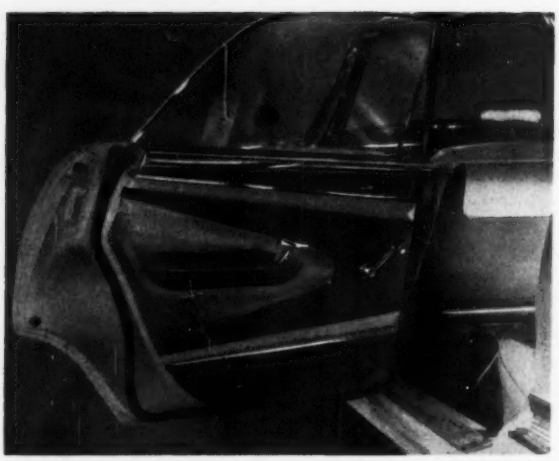
In the M.G. Magnette Mark III, the middle portion of each seat trim has a series of pleats, and there is a wide roll along the front and each side, giving support to the occupants when cornering at speed. French styling is exemplified in the Renault Dauphine Gordini by the use of two upholstery materials. The seat and squab coverings are made up from three smooth faces only; in each case, the two narrower side areas provide support for the body against sideways movement. Strip piping separates each portion from the next. The two-tone seat trimming on the new Ford de luxe Anglia has a wide central area with six pleats, surrounded by an outer roll trimmed in a contrasting colour. For this trimming, p.v.c. sheet, rayon cloth or leather may be chosen.

In the new Citroën Bijou coupé, the simple hammock type seats, as used on the 2 C.V. version, are built on steel frames which are left exposed. There are separate front seats, and the rear bench seat is hinged. The rear seating of the Porsche Super 90 has been redesigned, a change having been made from the folding bench type to a seat with two separate cushions, set low on each side of the central casing cover. Above each cushion is a backrest, which hinges downward to provide more boot space when extra luggage is to be carried. The rear compartment of the Mark 2 Jaguar incorporates a number of new features. Fitting into the upper part of the back of each front seat is a folding table, while the rear seat cushion is styled with a deep roll along the leading edge; this roll curves back at each end to meet the squab. The middle portion of the cushion has narrow fluting.

As on several previous occasions, a number of cars in relatively small-scale production have bodywork of glass reinforced plastics material. There is no doubt that, during the last few years, considerable progress has been made in this form of construction. An outstanding example of plastics bodywork is that of the Jensen 541R high-performance car, which remains basically unchanged from last year. Another application of polyester-glass bodywork to a sporting car is the Daimler SP250. This body is constructed from several large mouldings, which are bonded together to form a complete shell; the floor moulding embodies the propeller shaft tunnel, rear seat pan and rear wheel arches.

A large bulkhead moulding includes the toeboards and, in the middle, the gearbox cover. The main body skin, a

Below: The traditional Wolseley grille is retained in a shortened form on the 15/60 model. Middle: Elaborate door trim on the Dodge Dart Phoenix. In spite of the thickness, there is no provision of stowage space



Left: On the Austin Seven, the rain gutter runs right round the roof; the body pressings are united by externally flanged joints. Below: The Fairthorpe Electron Minor, plastics bodied car is available in kit form

Below the waistline, the bodies of the Triumph Herald saloon and coupé have common pressings. These bodies are not of the integral type and both have ample glass area. The rear light of the coupé is well raked

large single moulding, is bonded to these lower mouldings. An examination of the structure reveals that the form of the moulding has been used to impart rigidity at specific points. Examples of this technique are the large swages moulded over each wheel opening, the flared edge round the front of the cockpit, and the sharply defined shape of the headlamp cowls and rear fins. Relative simplicity of the bulkhead moulding is made possible by the use of a heavy metal windscreen frame completely embracing the glass. By virtue of the use of this frame, the need of reinforcement of the scuttle region has been reduced.

A company with considerable experience in moulding glass reinforced plastics material is Berkeley Cars Ltd. While their latest model remains basically the same as previously, the front end has been restyled to provide a deeper air intake for the larger engine now being used. For those interested in studying the mouldings used in the build-up of a reinforced plastics sports car body, the Fairthorpe Electron was displayed in kit form at Earls Court.

A newcomer to this field is the Citroën Bijou de luxe saloon already mentioned: it has an occasional four-seat saloon body with two doors. All the windows are frameless and of opening type, and the large boot lid is attached by a pair of outside hinges set at an angle in the extreme corners of the boot decking. Viewed from the rear, the roof moulding has a shallow rib along each side at the edge; these ribs obviate the need for gutters along the tops of the doors, and at the same time stiffen the roof moulding.

Peerless Cars Ltd. exhibited their G.T. Phase II 2-litre sports saloon, one version of which has an opening roof incorporated in the roof moulding of their reinforced plastics body. A portion of the roof panel is cut away and a light alloy frame is fitted into the opening. A mating frame, carrying a Webasco folding roof unit, is then installed. In the closed position, the folding roof is locked to the windscreen head-rail.

In addition to the use of reinforced plastics for complete body shells, there are numerous applications of such mouldings within normal bodywork. On the Aston Martin DB4, the gearbox cover and the rear seat pans are mouldings of this material, which is also employed on the new A.C. Greyhound for several hidden panels, such as those at the sides of the luggage boot.

One of the outstanding features of the 1960 American cars is the noticeable change-over from the almost universal separate chassis and body to some form of unitary construction. This is particularly interesting for the body engineer, in view of the fact that some British car manufacturers are moving away from this system.

Of models produced by the Chrysler Corporation, the Imperial retains its separate chassis, while for the Plymouth Fury a form of unitary construction has been adopted. This incorporates a pair of deep, box-section sills and a number of interior bulkheads along the length; under the floor is a cross bracing, and a heavy sub-frame is built into the

Middle: Hinged panels, to conceal the hood in the stowed position, are fitted to the Sunbeam Alpine sports car. Bottom: The unusual boot lid shape of the Panhard gives easy access from either side, as well as from the rear; the hinges are spring loaded towards the open position

front of the body. Design, development and testing of this layout have been proceeding over the past three years, and much work has been carried out on the large Chrysler test track. Improved rigidity of the bodywork is the primary reason given for this change of constructional methods.

Much has been done on the production models to treat the hidden surfaces of metal with rust inhibiting coatings, to prevent rusting away of the basic structural members such as the sills and cross members. Large holes are punched

The new Plymouth Valiant compact car from America attracted considerable interest at Earls Court. It is of unitary construction, and both the styling and decoration are noticeably restrained by U.S.A. standards

in the ends of each box section to ensure penetration of the primers during the three-dip process used. After dipping, but before baking, air pressure is applied down the sections in an effort to move any primer that may have collected against the inside plates, so that drying may be completely even over the whole of the inside surfaces.

The Plymouth Fury convertible model has two wide doors and separate, outward swivelling front seats, to facilitate entry and exit. On this car, the steering wheel is elliptical in shape; it is moulded in two-tone plastics material and incorporates a series of grooved hand grips. In the centre of the large boot lid, a dummy spare wheel cover, topped by a chromium finished nave plate, is embossed as a means of stiffening the otherwise almost flat area. Viewed from the side, this large car has a distinctly nose-down appearance, imparted by the stubby, upswept tail fins and by the downswept cowls extending out over the tops of the headlamps.

Halfway through the Show, the new Plymouth Valiant was put on exhibition. Examination reveals this to be of conventional unitary construction, having heavy box-section members and deep sills, with rails welded to the stressed panels. The shallow roof pressing has a pair of sturdy windscreen pillars, raked rearward from the scuttle; the rear quarters slope backward from the roof to join the rear bulkhead structure.

A novel application of tail fins was seen on the Dodge Polara. The waist-line runs in a gentle curve from above the twin headlamps, along the wings and on to a circular, rear lamp housing, giving a nacelle effect at the rear. Each fin starts halfway along the rear door, rises in a curve to its peak, and then drops almost vertically to a point some distance forward of the rear lamp group. This unusual arrangement is inclined to give the appearance of an afterthought.

That radical change in the outlook of the American buyer, which has brought into being the new type of compact car, was probably started in 1958 by the introduction of the Studebaker Lark saloon. An extension of the Lark range is a convertible body. This is similarly styled to the saloon but is provided with a folding hood that stows behind the rear seats, beneath a clip-on waterproof cover. The Ford Falcon four-door saloon has very restrained styling and, in some respects, is not unlike the British Ford Zephyr saloon, although there is a distinct depressed moulding in the side panels. The frontal styling of this car is distinctive: the wide grille, flanked on each side by a single headlamp, is recessed beneath the bonnet, which has a rolled over edge, and this undercutting extends into the two wings.

The Chevrolet Corvair, also shown for the first time, is revolutionary for American design practice, both in respect of the mechanical features and the structure, which is of welded chassis-body construction. Since the engine is at the rear, there is no central propeller shaft tunnel. At the front of the floor is the massive bulkhead assembly, with integral front wings. The rear bulkhead is equally robust and is formed by the rear seat pan, spanning the wheel arches, and an interior metal panel at right-angles to the rear decking. Sills of heavy section are provided beneath the doors, and they extend over the wheel openings with deeply formed swages at their edges. This very rigid under-structure is reinforced by the use of a well raised swaging on the body panels, a styling feature that extends right round the body, including the doors. The swaging is at a height that allows it to blend into the top of the vertical rear apron panel, and also into the separate section joining the two front wings above the frontal grille.

Centre pillars join the door sills to the roof cant rails, and a bridge, of top-hat section, joins the middle of each cant rail at a point above the centre pillar. Owing to the very rigid under-body, it has been possible to give a very light, airy appearance to the bodywork. An almost flat roof pressing

Left: The air intake grilles of the Citroën D.S.19 are unusually disposed, on the upper face of the front wings

Right: For the facia panel of the Wolseley 6/99, walnut veneer is employed. Padded rolls are fitted to the top of this panel and to the parcels tray edge

is used. This is supported at the front on a pair of well raked screen pillars, and overhangs the very large, curved rear window, which is bounded by the forward raked, slim rear pillars. The air cooling of the engine requires that the rear decking embodies an air intake, while below the rear bumper is a grille forming an outlet for the heated air.

Improved insulation against noise and fumes is a prominent feature of the latest cars. On Chrysler models, split rubber grommets are used in the bulkhead to form a good seal around the uneven section of the wiring loom. All large panels such as bonnets and boot lids are treated either with a layer of glass fibre insulation, or are sprayed with a bituminous compound. A similar treatment is given to bulkheads, while bituminized acoustic felt is fitted to roof and door panels as well as providing an underlay for carpets. On practically all British built quantity-produced bodywork real progress has been made in sealing and sound insulation. Bituminous compounds are sprayed on, directly after the assembly of the hull, to minimize vibration, and in order that the underneath of the floor and wheel arches are protected against corrosion. Roof panels are also sprayed with compound, or are fitted with a layer of felt and then overlayed with a washable, p.v.c. headlining.

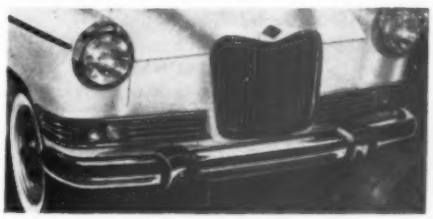
Finally, while there is little to be learned from either the construction or styling of the Russian built Moskvitch saloon, there is a noticeable ruggedness about the bodywork. One example of this is found at the edges of each wheel opening, where the metal is flanged not only inwards but upwards as well, thereby forming a channel section round that normally unsupported area. This could, however, lead to rusting. The same robustness is apparent at the base of each centre pillar, where a relatively large radius is introduced to provide a substantial foot at the joint with the door sill. This radius necessitates a similar radius at the bottom of each door, a matter of little consequence. The welding of the underfloor structure is certainly rough but it is continuous, and much of it looks as though done by gas rather than by the more generally used methods of spot or roller welding. In general, the thickness of metal used appears to be greater than is normally regarded as necessary.

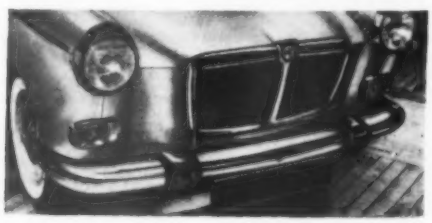
While the number of firms exhibiting in the Coachwork Section of the London Show continues to decline, the quality of craftsmanship remains unimpaired. The new Bentley Continental drophead coupé, by Park Ward and Co. Ltd., is an example of harmonious relationship between height, length and breadth dimensions. The original objective of the designers was to emphasize the length and reduce the effective height. This has been achieved by a style based on a continuous crown line on each side, sweeping from headlamp along the waist of the doors to the rear lamp, in one complete movement. To emphasize further the effect of length, the radiator shell has been positioned well forward, given a three-degree forward tilt, and lowered three inches relative to that of the earlier model; also, the bumper has been raised to the normal position, at the bottom of the radiator shell. Additional emphasis on length is provided by the use of a wrap-round screen with the pillars leaning back from the waist line, while the crown line of the boot is high relative to the rear wings. Sheet steel is used for the stressed components, such as the scuttle, floor, rear seat pan, boot floor and rear wing and quarter panels. The other body panels, such as the bonnet, boot lid, doors and wings, are of light alloy.

Each of the two separate front seats are anatomically designed. Crash-pad rolls, covered with leather, are fitted along the waist rail of each door and on top of the facia panel; the portion on the facia is covered with black leather to obviate reflections in the windscreen. All the instruments are grouped together in a beautifully shaped panel: this is probably the first time such a grouping has been applied to this class of car made by a British coachbuilder.

The full-width rear seat and squab has a central, folding armrest which, when open, allows a spring flap to drop into place to close the opening in the squab. A simple catch in the centre of the panel in front of the hood storage compartment can be released to allow the whole rear squab to pivot forward on to the cushion to provide additional space for suitcases. Ample pockets are provided unobtrusively behind the trim panels on the doors.

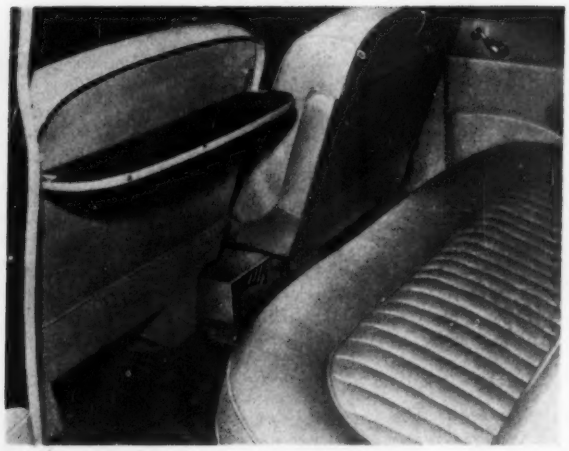
A limousine body, built by Park Ward, on the latest Rolls-Royce P5 chassis, is an example of advanced design in respect of the distribution of cool air throughout the rear compartment. Refrigeration plant is installed behind the rear seat squab. From it, ducting is carried up the rear quarters, between the outer panels and the headlining, to a longitudinal slot formed in the lining on each side, above the cant rail, for the entry of cool air. Air is extracted through grilles set in a horizontal panel behind the rear





Although the pressings of the Riley 4/Sixty Eight and the M.G. Magnette Mark III are largely common, there are major differences in the frontal treatments of these Farina styled cars

The Chrysler Corporation has gone over to unitary construction on a number of models including the Dodge Dart Phoenix shown here. Slim pillars have been made possible by the strength of the car's underbody structure



The Jaguar Mark 2 has many points of difference from the standard 2·4- and 3·4-litre cars. Among them is the improved method of distributing heat to the rear passengers, through a grille above the floor tunnel

seat immediately below the rear window. Each of the two front seats is fitted with a pair of folding armrests.

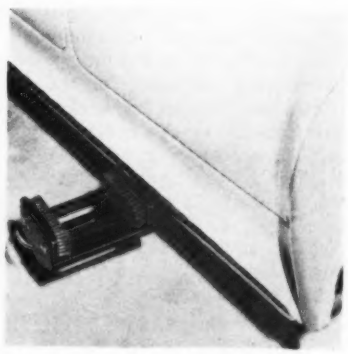
The old established firm of Hooper & Co. (Coachbuilders) Ltd. made their last appearance at the London Show this year. They exhibited a pillarless, two-door, four-seat saloon on the latest Daimler SP250 chassis. The bodywork is in the knife-edge style, and has a very low bonnet line. Its two-piece grille retains the well known Daimler fluting. Aluminium construction, and a very shallow roof panel are features of this body. Each edge of the roof panel is flared upwards to provide a water gutter on the top of the roof instead of along the cant rail. This knife-edge along the roof is matched by another, from front to rear, along the crowns of the wings. On each side of the vehicle, the side-lamp, which is above the headlamp, is housed in the front end of this second knife-edge section.

Several examples of Countryman conversions were exhibited by Harold Radford (Coachbuilders) Ltd. These cars set a high standard in coachbuilding as well as provide a number of unique features. One body, on a Bentley S.2 chassis, has a readily removable division behind the two front seats, so that it can be used as either a saloon or a limousine. The boot lid has been restyled to introduce a transverse knife-edge line, matching a similar line across the roof panel above the rear window. But this restyling also has a practical value in that it raises the top of the boot lid by three inches and so provides additional volume for luggage inside the boot.

A Webasto sliding roof unit is fitted to the main roof panel. Ahead of it is an easily adjustable transparent wind-deflector. Built into the boot floor is a sturdy picnic table, which is hinged and can be swung outwards over the rear bumper. It has a Formica covered top, but a rubber mat can be placed on it so that it can be used as a stand from which races and other outside activities can be viewed. A wide range of accessories is provided on these Countryman conversions, so full use is made of all available space, inside the body, to house them. Each of the four doors has a number of specially designed compartments let in behind the trim panels. These compartments are of moulded reinforced plastics, covered by hinged flaps. The central armrests are of box form, with forward hinging tops to house small items; folding tables are fitted to the backs of the front seats; and below these, more compartments with forward hinging lids, house glasses and liquid refreshments in racks. One interesting accessory introduced this year is a shoe-scraper which has a long handle to fit into the car jacking tube under the body; after use, it is pulled out and stowed away in the boot.

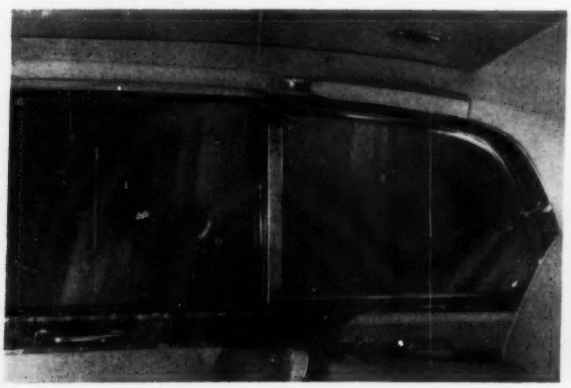
The rear seat squabs of these cars fold forward to increase the luggage space available; this, of course, is normal practice, but Harold Radford have gone a stage further, in that they have divided the rear squab into two separate parts, the division being such that one part of the seat will accommodate two persons and the other one person. Thus, the amounts of space allocated to passengers and luggage can be widely varied to suit requirements.

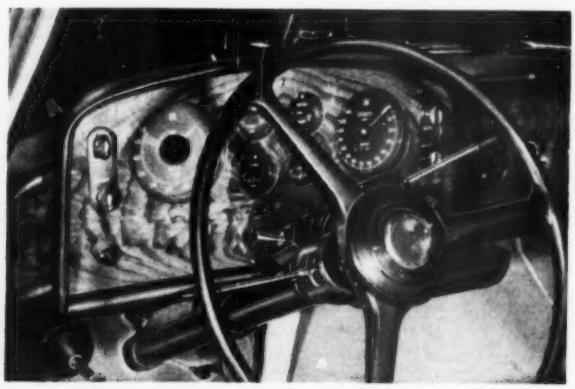
James Young Ltd. exhibited specialist coachwork on Rolls-Royce and Bentley chassis. The construction of each is based on light alloy framing with steel as reinforcement.



A useful detail on one of the Harold Radford Countryman conversions was this shoe cleaner. It stows away in the boot and, when needed for use, is mounted in the jacking tube below the side

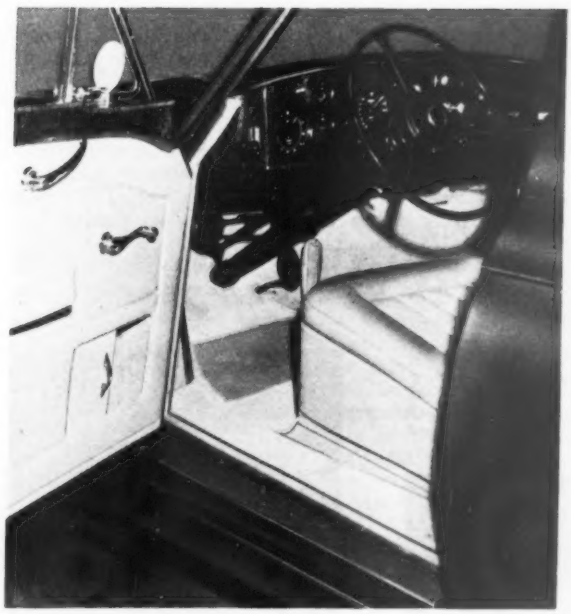
Below, left: In the Park Ward limousine on a Rolls-Royce chassis, slots in the head lining are used to distribute cooled air from the refrigerator system. Below, right: For the first time, the Bentley Continental body by the same coachbuilder features grouped instruments in a separate panel





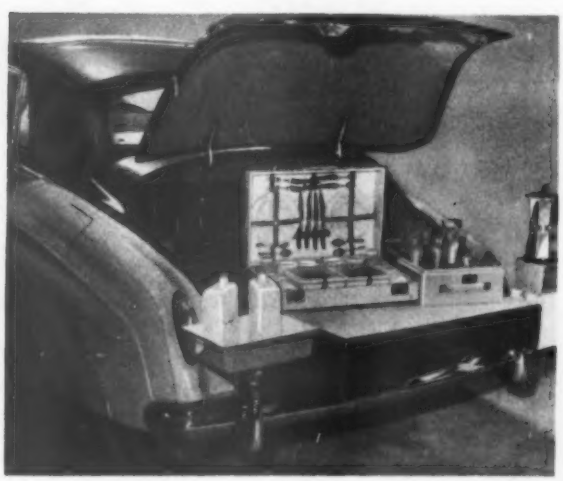
Left: Each front seat on the Rolls-Royce Park Ward limousine has a pair of folding arm rests. Those for the driver hold him firmly when cornering

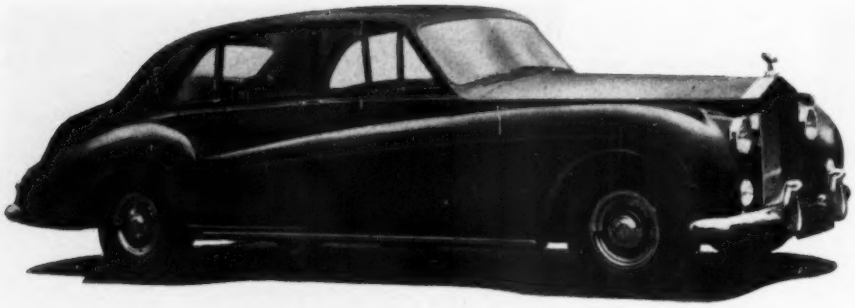
Right: On the Radford Countryman conversion on a Bentley chassis, a picnic table, hinged to the boot floor, can be used as a stand for viewing sports events



Above: For additional luggage space on the Park Ward Bentley Continental, the rear squab folds flat. Left: Luxurious equipment is a feature of the James Young body on a Bentley Continental chassis. The door cappings and facia are in walnut, and the door pockets have sliding flaps

Below, left: In the doors of the Harold Radford Bentley conversion, provision is made for stowage of liquid refreshment. Above the left-hand compartment is a pipe rack. Below: All the high-grade accessories displayed on the picnic table of the Radford Bentley are supplied as part of the conversion and are neatly stowed internally





Dignity of line and proportions is the keynote of this touring limousine by James Young on the Rolls-Royce Phantom V chassis. The lavish equipment includes occasional seats, folding tables and a set of picnic equipment

Heat and sound insulation are incorporated during the construction and a special draught seal is installed during assembly.

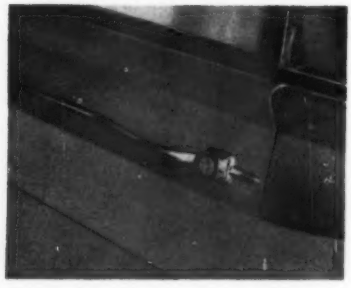
There is a faint suggestion of fins on the tops of the rear wings of a body on a Bentley S.2 chassis. They form a deep channel on each side of the boot, to carry rain water away from the roof directly to the ground. The absence of polished mouldings on the exterior is a feature of this attractive body. Door control buttons of square section are set in fine handles which extend for a short distance along each door, fore and aft of the centre pillar. Inside the vehicle, the facia is finished with polished walnut, each end being curved towards the door pillars. In the lower part of each door, a small sliding panel gives access to a compartment behind the trim.

A touring limousine and a seven-passenger body, for a chauffeur driven vehicle, are other examples of the work of James Young Ltd. Lockers with sliding shutters are built into all four doors, while the central armrest in the rear compartments incorporates a glove locker. Behind the division, figured walnut cabinet work is used for two folding tables with mirror-backs, while in the centre, a small door can be opened to give access to a set of cut glasses and a decanter.

On the stand of H. J. Mulliner & Co. Ltd. a drophead coupé body on a Rolls-Royce Silver Cloud chassis was shown. Its main stressed components are of pressed steel, while the unstressed panels, such as the bonnet, boot lid and doors, are of aluminium sheet. This body accommodates six persons. There are central armrests in the front as well as the back seats, and each door also is fitted with an armrest. The hood is power operated and folds completely away, the control mechanism being under the rear seat. Figured walnut is used for the facia panel and door cappings, while the whole interior is trimmed in grey hide.

An example of a standard car body converted to a high quality vehicle is the Princess model, by Vanden Plas (England) 1923 Ltd. This vehicle is, in effect, a luxury version of the Austin A 99. The interior is styled in simple dignity, the finest materials being employed. All the seats,

The two left-hand illustrations below are of the Hooper G.T. body on a Daimler SP250 chassis. Knife-edge styling is employed, and flashing indicators are embodied in the corner ribs of the roof panel. Right: Elegant door handles on a James Young body. Bottom right: Another Radford Bentley feature is a divided and folding rear seat layout



with their deep edge-rolls, are noteworthy for their comfort; separate front seats are provided in the saloon version, while the limousine has a bench seat with a division behind it. Pleated map-pockets are provided below the sloping armrests on each door, except on the driver's side. The facia panel, with instruments grouped around the steering column, is finished with fine-grain walnut veneer, and the instruments are deeply recessed to avoid reflections.

Special attention has been given to noise insulation: the bonnet has been lined with a thick, glass-fibre insulating blanket, while the headlining shows a new approach to the anti-drumming problem, a woollen headlining material being bonded to a rubber sheet, which in turn is secured directly to the steel roof panel. Below the facia, a long shelf, divided into two portions, provides ample room for the stowage of maps, books and small parcels.

The exterior styling is distinctive by virtue of the use of a rectangular grille, with a slightly overhung bonnet. On each side, a pair of vertical panels occupy the space between the grille and each front wing. Few embellishments are employed, the only ornamentation being a coronet motif on the nose of the bonnet and a small letter P on each of the nave plates.

Throughout the coachwork section, the increasing use of high quality materials such as West-of-England cloth and leather for trimming materials, and the universal employment of wood veneers for interior finishers are the outward signs of craftsmanship. This is backed by design on sound engineering principles.

Because these custom-built vehicles are frequently used for long distance, high-speed touring abroad, emphasis is on the provision of luggage space additional to that in the boot. From a constructional point of view, it is not difficult to do this by hinging the rear squab forward, provided the vehicle is based on a separate chassis and the need for a stressed bulkhead behind the rear seat is therefore eliminated. The design of seating for comfort has made considerable progress, particularly in respect of the use of the hammock method of construction, by which the seat is made to conform automatically to the shape of the individual body.

Cleaning Fuel Injection Nozzles

An Automatic Machine for Continuous Operation to Clean and Dry Nozzles

AUTOMATICALLY operated machines for cleaning fuel injection nozzles are now available from the Alfa-Laval Company Ltd., Great West Road, Brentford, Middlesex. They are the Parawash machines, through which the nozzles are carried on specially designed conveyors. The first conveyor is driven by means of a Geneva motion. It comprises slats positioned laterally between two chains. On the slats are locating pins on which the injection nozzles are placed by hand and then conveyed along a tunnel to a station beneath a set of jets. During the actual cleaning operation, the conveyor is at rest, and the jets are automatically brought down on to the nozzles and a stream of solvent is pumped through each; there are also auxiliary jets, both at each side and under the conveyor, through which solvent is continuously sprayed to wash the slats and the exteriors of the nozzles.

After an interval of 12 sec, the conveyor moves again and the washed nozzles are passed on to another station, where again the conveyor is stopped. At this point, another set of jets comes down on to the nozzles, but this time compressed air is blown through them to dry the surplus solvent from the nozzles; at the same time additional jets come into operation, from the sides, to assist in the drying of the exteriors of the injection nozzles. After another interval of 12 sec, which is long enough for the drying operation, the conveyor moves again and the nozzles fall on to a Neoprene conveyor below. This second conveyor carries them along to an unloading tray. A scraper device ensures that the Neoprene conveyor is keep free from solvent. The sequence of operations is, of course, continuous, and while each set of nozzles is being dried, another set is being washed and others are following on.

The movements of the jets for the washing and air drying operations are effected by compressed air, controlled by a cam-actuated valve synchronized with the movement of the conveyor: this ensures that the jets move at the appropriate points in the cycle. Although the solvent is pumped through the washing jets continuously, the air for drying is controlled by a solenoid valve that is opened and closed by a cam-operated switch, so that unnecessary wastage of air is avoided.

A storage tank for the solvent is installed beneath the conveyor assembly. It is divided into two compartments, one to receive the dirty solvent, draining from the cleaning station, and the other for clean solvent. A de-mister is provided for extracting solvent mist from the washing tunnel. It collects the mist and spins it to precipitate the solvent, which is then returned with the dirty solvent to the tank. A centrifugal pump delivers dirty solvent continuously from the first compartment to a De Laval centrifuge type clarifier, whence it gravitates into the compartment for clean solvent. Another centrifugal pump delivers the clean solvent at a pressure of approximately 40 lb/in^2 from the second compartment to the jets. Air for drying and for operating the jet advance and retraction jacks is supplied at approximately 80 lb/in^2.

The motors are all controlled by means of push-button starter switches on a control panel fitted to the side of the equipment. These switches are arranged so that the motors can come into operation only in the correct sequence; also, they are interconnected with the solenoid valve to ensure that, when the main switch button is first pressed, air is immediately supplied to the equipment so that all the jets will operate correctly as soon as the conveyor is started.

The Parawash automatic machine for cleaning fuel injection nozzles. Beneath the conveyor assembly is the twin-compartment storage tank

Recent Publications

Brief Reviews of Current Technical Books

Tool Engineers Handbook

London: McGraw-Hill Publishing Co. Ltd., McGraw-Hill House, 95 Farringdon Street, E.C.4. 1959. 9½ × 6. 2,289 pp. Price £7 11s.

This is the second edition of a reference book that deals with all phases of planning, control, design, tooling and operations in the manufacturing industries. It has been revised under the supervision of the American Society of Tool Engineers Technical Publications Committee. During the period since the first edition was compiled, great contributions have been made to progress in respect of the use of new machines, tools, materials, standards and methods in production techniques. Included among these advances are automation, numerical control, electro machining, trepanning, shell moulding, learning curves, and so on. Furthermore, management has progressed far: specialists have merged into study groups, and development committees have supplanted powerful individualists.

The revision of the handbook has been entrusted to industrial committees and has involved the co-operation of some 400 men from 300 organizations in and connected with industry. Obviously, it is impossible to list all the subjects covered in the 2,289 pages. In general, the work deals with the latest aspects of tool design, fabrication, maintenance and utilization. It covers subjects from product design and cost estimating to the economic selection of machines, processes and tools, and finally the analysis and improvement of set-ups and operations. Among the subjects covered are surface cleaning by supersonics, electrolytic grinding and many other recently developed techniques.

The Effect of Technological Progress on Education

London: The Institution of Production Engineers, 10 Chesterfield Street, Mayfair, W.1. 1959. 10 × 8. 141 pp. Price 14s. 6d.

This is a classified bibliography from British sources, 1945 to 1957. It is obtainable from the Publications Department of The Institution of Production Engineers. The bibliography is not comprehensive, but is intended to be a guide to technical education during the period covered. Independently of its use as a bibliography, it should serve as a summary of opinion on the subject. This work has been prepared by the Institution's Hazleton Memorial Library, and the Institution states that so far as it is aware, this is the only bibliography of its kind so far issued. Under the Schedule of Classification, the following are the main headings: Technical education and training; Organization of technical education; Pre-school and elementary or primary education; Intermediate secondary education; Industrial training; and the last section is Higher technological education.

TECHNICAL BOOKS FOR

Christmas

For those who wish to give technical or semi-technical books as Christmas presents, the following can be obtained through any bookseller or directly from Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

CAR DRIVING AS AN ART. 12s 6d
GO CONTINENTAL—BY CAR. 17s 6d
VALUE-FOR-MONEY MOTORING. 7s 6d
CARAVANNING AND CAMPING FOR MOTORISTS. 8s 6d
HINTS AND TIPS FOR MOTOR CYCLISTS. 7s 6d
SCOOTERS AND MOPEDS. 7s 6d
IMPROVE YOUR TELEVISION RECEPTION. 5s
CORRECTING TELEVISION PICTURE FAULTS. 3s 6d
PHOTOGRAMS OF THE YEAR, 1960. 18s 6d
DICTIONARY OF PHOTOGRAPHY. 21s
THE COMPLETE AMATEUR PHOTOGRAPHER. 25s

The Autocar Road Tests, Autumn 1959

London: Iliffe and Sons Ltd., Dorset House, Stamford Street, S.E.1. 1959. 11⅛ × 8⅛. 80 pp. Price 6s. 6d.

This publication now appears twice a year, which means that up-to-date tests are available in book form at the two periods when interest is at its peak—the Autumn edition is in time for the London Motor Show, and the Spring edition gives readers the latest information at the start of the buying season. In the current work there are road test reports and full performance data of twenty of the latest models, twelve British, three American, three German, one French and one Italian. Each contains a description of the car's behaviour under varying conditions, compiled after some hundreds of miles' running in the hands of experts; comments on its construction and design; detailed plans showing the controls, instruments and seating arrangements, with all important dimensions; numerous photographs and full technical information. A table of performance figures for all the cars featured in the book is also included, to facilitate comparison.

The cars dealt with in the Autumn 1959 edition are as follows: Armstrong Siddeley Star Sapphire, Austin A55 Cambridge de luxe, Austin Gipsy, Auto Union 1000, Dodge Custom Royal, Elva Courier, Fiat 500 (convertible), Goggomobil TS400, M.G. Magnette III, NSU Prinz, Pontiac Bonneville, Rambler American, Renault Dauphine Gordini, Rover 3 Litre, Standard Vignale Vanguard, Triumph Herald Coupé, Triumph Herald Saloon, Vauxhall Friary Estate Car, Vauxhall Victor de luxe, Wolseley 6/99 (automatic).

The Sports Car: Its Design and Performance

By Colin Campbell, M.Sc., A.M.I.Mech.E.

London: Chapman and Hall Ltd., 37 Essex Street, W.C.2. 1959. 8¼ × 5½. 285 pp. Price 30s.

The first edition of "The Sports Car" was printed no less than five times and this second edition, which has been carefully revised and brought up-to-date, will undoubtedly be welcome. Alterations have been made in the chapters dealing with design features in respect of which progress has been made since the first edition was published. Among the new developments are the availability of 100 octane petrol, improvements in bearing materials and substantial increases in specific power outputs. Because of these developments it has been necessary to revise performance data, and new examples have been selected to illustrate commendable engine design features. Other new material in the edition includes details of roller bearing crankshafts, pneumatic suspension, the latest suspension dampers, drag coefficients and disc brakes.

This work is well illustrated and the chapter headings are as follows: The development of the sports car. The engine: cylinder head design. The engine: induction and exhaust. The engine: miscellaneous components. The engine: the trend of design. Road-holding. The suspension. The chassis frame and body. The transmission. The brakes. Tuning. Performance. Future development. This book will be of interest and practical value not only to the enthusiastic novice, but also to designers actively engaged in creative work in industry.

Trade Union Law

By H. Samuels, O.B.E., M.A.

London: Stevens and Sons Ltd., 11 New Fetter Lane. 1959. 8¼ × 5½. 108 pp. Price 17s. 6d.

It is surprising to learn that this book has recently been published in a Japanese translation, so evidently the mode of treatment of the theme is of interest to a wide field of lawyers and laymen. The work under review is the sixth edition of the English version; it has been designed to present, in as brief a compass as the subject will permit, the law relating to trade unions. Since the appearance of the previous edition, the Industrial Disputes Order (S.I.1951, No. 1376) has been revoked, and has been revised by an enactment of far more limited scope, that is, section 8 of the Terms and Conditions of Employment Act, 1959. The author has been able, without unduly enlarging the book, to include some paragraphs on topics such as collective agreements; strikes, restrictive practices; trade union rules; procedure; picketing; registration; disciplinary powers; disputes.

The list of contents is as follows: Preface; Table of cases; Table of statutes; Trade unions in general; Membership of trade unions; Contracts of trade unions; Civil wrongs outside trade disputes; Civil wrongs where there is a trade dispute; Criminal conspiracy and intimidation; The rules of trade unions; The political funds; Registration of trade unions; Property and liabilities of trade unions—amalgamation—dissolution—nominations; Legal proceedings; Appendix, forms; and, finally, the index.

Exhaust Back Pressure

Its Effects on the Performance of Internal Combustion Engines

S. E. Bonamy*, B.E., M.Sc., A.M.I.Mech.E., A.M.I.E.(Aust.) and R. W. Uppold*, B.E., G.I.Mech.E.

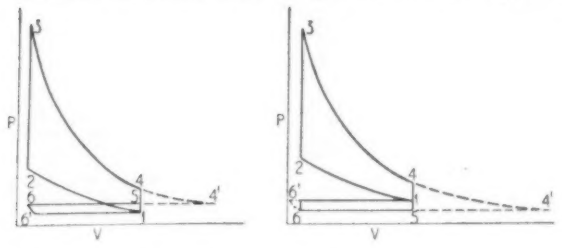
CRITICAL examination of the effects of exhaust back pressure variation on the performance of internal combustion engines becomes necessary in many instances, for example, aircraft flying at various altitudes, turbocharged engines, and engines operating with restricted or assisted exhaust systems. A theoretical analysis of the phenomena, which takes into account such factors as chemical dissociation, specific heat variations and the effects of residual gases from the previous cycle, is best made by the application of thermodynamic charts. The charts prepared by Hottel, Williams and Satterfield[1] are ideally suited for this work and are here applied to examine critically an Otto cycle engine of 6·5 : 1 compression ratio for a wide range of intake and exhaust manifold pressures.

The temperature of the incoming charge has been considered constant at 600 deg R, which is an average value obtained from tests on a 60 b.h.p. automobile engine at a speed of 2,500 r.p.m. It is assumed that the fuel-air ratio is 1·2 times that theoretically required for complete combustion. Back pressures ranging from 6 lb/in² abs. to 20 lb/in² abs., in 2 pound increments, were chosen for intake manifold pressures of 6, 8, 10, 12 and 14 lb/in² abs., making a total of 40 cycles analysed. In cases where the back pressure was less than the intake pressure, the cycles were considered as for a supercharged engine, Fig. 1(b), their analysis being greatly simplified by assuming the residual gases at point 6 to be compressed isentropically, by a portion of the incoming charge, to intake pressure, point 6′, as described by Bonamy.[2]

Procedure

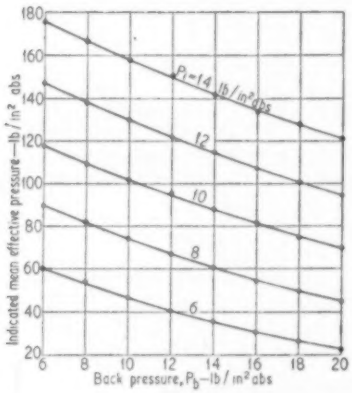
In general, the procedure adopted in solving a cycle with the aid of the charts is, briefly, as follows: A temperature, T_1 and a weight fraction f of residual gases in the equivalent burned mixture at the beginning of compression are assumed. For the chosen value of intake pressure P_1 and temperature T_1, a point is located on the Modified Air Chart[1] and the corresponding thermodynamic properties read off. Properties at point 2 are then found by following an isentropic compression process to volume V_2, which is equal to V_1/r_s allowance being made for mixture strength and presence of residual gases. The internal energy, per pound of air constituents, at point 3 is determined by adding the energy of combustion to the energy at point 2, to which a chart conversion factor is applied; application of the same factor to V_2 gives volume V_3, and point 3 is located on the appropriate Burned Mixture Chart — chart conversion factors are necessary since the Modified Air Chart and Burned Mixture Charts are plotted on a different basis — Isentropic expansion to volume V_4, which is equal to rV_3, and to the chosen exhaust pressure P_4', reveals properties at points 4 and 4′ respectively.

Fig. 1. Ideal pressure-volume diagrams for the Otto cycle: Left: with exhaust back pressure greater than intake pressure and, right, with the exhaust back pressure at a lower value than the air intake pressure



The gas remaining in the cylinder at point 5 is assumed to have undergone an isentropic expansion within the cylinder, from condition 4, doing work on the expelled gas during the process. Its condition corresponds to that at point 4′. Since process 5-6 is considered a constant pressure adiabatic one, the properties per pound of air constituents at point 6 are the same as at 4′. Further isentropic expansion, Fig. 1(a), or compression, Fig. 1(b), from point 4′ to intake pressure on the Burned Mixture Chart reveals properties at point 6′. Since the process 6′-1 is also considered a constant pressure adiabatic one, addition of the weight fraction f of residual gases to the weight fraction $(1-f)$ of fresh charge gives the enthalpy per pound of air constituents at point 1. Application of a chart conversion factor allows the enthalpy per mol. at point 1 to be calculated, and the corresponding temperature T_1 is read from the Modified Air Chart for the appropriate mixture strength. T_1 and f, which is equal to $V_6/V_{4'}$, are then checked with the assumed values and, if found unsatisfactory, the complete cycle is repeated using the new values.

Fig. 2. Curves showing the variation of mean effective pressure with the manifold pressure



Instead of calculating the work per cycle per pound of air constituents[1], it has been found more convenient, for comparative reasons, to calculate the work per cycle per unit swept volume and hence the indicated mean effective pressure.

$$\text{Work done, excluding pumping work} = \frac{(e_3-e_4)-(e_{s2}-e_{s1})}{1-f}$$

B.Th.U/lb of fresh charge .....(1)

where e = internal energy per pound of air constituents at appropriate points, and the suffix s indicates that the chemical energy is excluded.

The pumping work can be estimated with negligible error by assuming the pumping loop, in all cases, to be rectangular:

*School of Mechanical Engineering, Univ. of New South Wales (Wollongong Div.)

$$\text{Pumping work} = \frac{(P_5 - P_1)(V_1 - V_6)}{1-f} \times \frac{144}{778} \text{ B.Th.U/lb of fresh charge}$$

$$= \frac{(P_5 - P_1)V_1(r-1)}{r(1-f)} \times \frac{144}{778} \text{ B.Th.U/lb of fresh charge} \quad \ldots\ldots(2)$$

where r = compression ratio

$$\therefore \text{ Net work done} = \frac{(e_3 - e_4) - (e_{s2} - e_{s1})}{1-f} - \frac{(P_5 - P_1)V_1(r-1)}{r(1-f)} \times \frac{144}{778} \text{ B.Th.U/lb of fresh charge} \quad \ldots\ldots(3)$$

Heat available/lb of fresh charge = weight of fuel used × calorific value $= 0{\cdot}06775 \times F \times 19{,}040$ B.Th.U ....(4)

where F = fraction of theoretical fuel

Since, for a constant F, the heat available/lb of fresh charge is constant,

Thermal efficiency = constant × net work done/lb of fresh charge.....(5)

The volume of fresh charge entering per cycle = volume ratio × swept volume.....(6)

where volume ratio $= \frac{V_1 - V_{6'}}{V_1 - V_6} = \frac{r - \frac{V_{6'}}{V_6}}{r-1}$

Specific weight of charge at the beginning of compression $= \frac{1-f}{V_1}$ lb/ft³

$\therefore$ Weight of fresh charge entering engine per cycle

= volume ratio $\times \frac{1-f}{V_1}$ lb/ft³ swept volume .....(7)

Hence, net work done per cycle

$$= \left\{ r - \frac{V_{6'}}{V_6} \over (r-1)V_1 \right\} \left\{ (e_3 - e_4) - (e_{s2} - e_{s1}) - (P_5 - P_1)V_1 \frac{(r-1)}{r} \times \frac{144}{778} \right\}$$

B.Th.U/ft³ swept volume .....(8)

Indicated mean effective pressure

$$= \left\{ r - \frac{V_{6'}}{V_6} \over (r-1)V_1 \right\} \left\{ (e_3 - e_4) - (e_{s2} - e_{s1}) \quad \frac{778}{144} - (P_5 - P_1)V_1 \frac{(r-1)}{r} \right\}$$

lb/in² .....(9)

Analysis of results

Results from the computations that are of particular interest are the net work done per unit swept volume, thermal efficiency, weight fraction of residual gases, f, and the temperature T_1 at the beginning of the compression.

In Fig. 2, the indicated mean effective pressure is plotted against back pressure, for various intake manifold pressures. Small increases in back pressure are seen to have a very serious effect on the power output of an engine. For example, at an intake pressure of 14 lb/in² abs., an overall change of back pressure from 6 to 20 lb/in² abs. reduces the mean effective pressure by approximately 30 per cent, that is, more than 2 per cent per pound increase in back pressure. The effect becomes far more serious at low intake manifold pressures: at 6 lb/in² abs. intake pressure, a reduction in mean effective pressure of 63 per cent is realized for the same range of back pressure, that is, approximately 4 per cent reduction per pound increase in back pressure.

The variation in thermal efficiency with back pressure for various intake manifold pressures is shown in Fig. 3. At an intake pressure of 14 lb/in² abs., a reduction in efficiency from 34·3 per cent to 31·5 per cent is realized by a change in back pressure from 6 lb/in² abs. to 20 lb/in² abs. The reduction is much greater at lower intake pressures: at 6 lb/in² abs., the same increase in back pressure reduces the thermal efficiency from 33·1 per cent to 23·7 per cent.

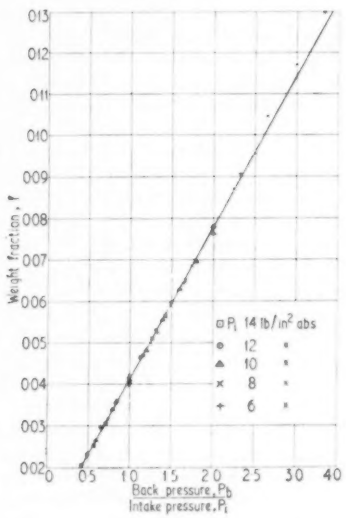


Fig. 5. The weight fraction, f, plotted against manifold pressure ratio

In Fig. 4, curves of weight fraction of residual gases f are plotted against back pressure for the various intake pressures. Since these curves, when produced, intersect at a common point and the horizontal intercepts between them are equal, a relationship of the form $f - C_1 = C_2 \frac{(P_b - C_3)}{P_i}$ exists, where C is a constant. However, a direct plot of f against P_b/P_i, Fig. 5, for all cycles analysed reveals that, to a close approximation, f is directly proportional to P_b/P_i.

Fig. 4. Variation of the weight fraction of the residual gases with manifold pressure

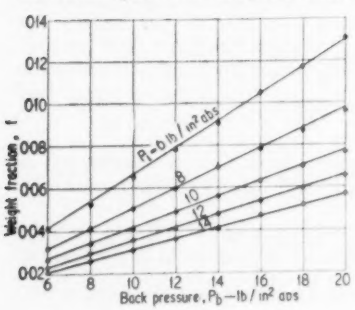


Fig. 7. The temperature T_1 plotted against the weight fraction of the residual gases

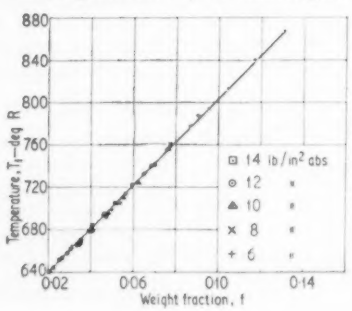
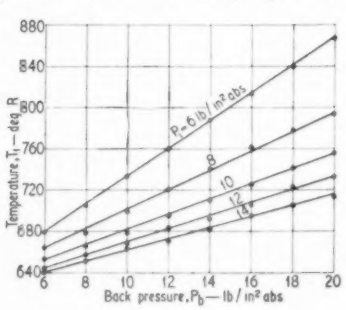


Fig. 6. Curves showing variation of temperature T_1 with the manifold pressure



A plot of temperature T_1 against back pressure, Fig. 6, shows that a similar relationship to that of Fig. 4 exists, that is, $T_1 - C_4 = C_5 \frac{(P_b - C_6)}{P_i}$ and indicates a rapid increase in T_1 with back pressure, particularly at low intake manifold pressures.

In Fig. 7, a graph of T_1 plotted against f, for all cycles considered here, reveals an exact straight line relationship.

Conclusions

The thermodynamic charts prepared by Hottel, Williams and Satterfield, together with the modifications suggested here, have proved to be of particular value in analysing theoretically the effects of back pressure on engine performance. Thermodynamic properties at all relevant points in an engine cycle can be readily obtained from them, for calculation of the various quantities. The accuracy of the charts is clearly shown by the lack of scatter of points calculated from them, as plotted in the accompanying graphs.

The theoretical effects of back pressure on engine performance are as follows:

(1) A marked percentage reduction in indicated mean effected pressure occurs with increased back pressure, particularly at low intake manifold pressures, Fig. 2. Reductions of approximately 2 per cent per pound increase in back pressure at 14 lb/in² abs. intake pressure and 4 per cent per pound increase at 6 lb/in² abs. intake pressure have been realized. This, no doubt, is caused by the increased weight fraction of residual gases, as back pressure is increased, Fig. 4, which reduces the effective volume of fresh charge taken in per cycle. Also, the presence of residual gases increases the temperature of the charge at the beginning of compression, Fig. 5, reducing its density and, therefore, the mass of fresh charge taken in per cycle. Pumping work plays a predominant part, in reducing the net output, only when high back pressures are coupled with very low intake manifold pressures.

(2) The thermal efficiency of an engine is reduced with increased back pressure, particularly at low intake pressures, Fig. 3. Reductions from 34·3 per cent to 31·5 per cent at 14 lb/in² abs. intake pressure and 33·1 per cent to 23·7 per cent at 6 lb/in² abs. intake pressure were realized for a change in back pressure from 6 lb/in² abs. to 20 lb/in² abs. The work output, excluding pumping work, per pound of fresh charge, remained approximately constant for all cycles considered, so that the only change in net work done per pound of fresh charge was due to the pumping work. Since, from equation 5, efficiency is directly proportional to the net work done per pound of fresh charge, it is therefore, dependent on the pumping work.

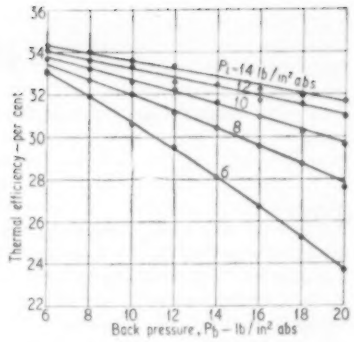


Fig. 3. These curves show the variation of thermal efficiency with the manifold pressure

The weight fraction of residual gases can be assumed with reasonable accuracy, to be directly proportional to the pressure ratio $P_b:P_i$, Fig. 5. At the beginning of compression, the temperature T_1 is directly proportional to f and independent of the pressure ratio $P_b:P_i$, Fig. 7. These relationships differ with the approximate equations given for f and T by Hottel, Williams and Satterfield, which were found most unsuitable for calculating f and T_1 with any accuracy in the examples considered.

References

1. H. C. HOTTEL, G. C. WILLIAMS AND C. N. SATTERFIELD: 1949, "Thermodynamic Chart for Combustion Processes", Parts 1 and 2, *John Wiley*, New York.
2. S. E. BONAMY: "Solution of Supercharged Engine Cycles", *Automobile Engineer*, Oct. 1959.

Titanium Valves for Compressors

UNTIL recently, the use of titanium has been confined almost entirely to the aircraft industry, largely on account of the high cost involved. There are indications, however, that the remarkable properties of this metal will be exploited to an increasing extent in other spheres. One of the latest applications of titanium is to replace steel in the plate valves of Broomwade stationary air compressors, manufactured by Broom and Wade Ltd., High Wycombe, Bucks.

In normal working conditions, the steel plate valves had been found to give satisfactory service. On the other hand, where the conditions were abnormal, particularly in respect of relatively high ambient temperatures, the life of such valves was limited, because of both temperature effects and corrosion. Since titanium is tough and its resistance to high temperatures and corrosion is good, the possibility of using it for this application was investigated by the Broom and Wade research department. Extensive trials with titanium valves showed that, even in the worst conditions, their life should be equal to that of the compressor. It was felt by the company that the greater cost of the titanium component was more than outweighed by the elimination of the possibility of breakdown. The weight of a typical titanium valve is given as 4·51 gm, as against the figure of 7·86 gm of the equivalent valve of steel construction.

British Standards for Antifreeze

IN THE present state of knowledge, the British Standards Institution has found it impossible to prepare one antifreeze specification that would be suitable for all types of engine. Consequently, it has been necessary to issue three new Standards covering formulations that have been found satisfactory in use. Owing to the differences between one engine and another, users are advised to ascertain from the engine manufacturer what type is the most suitable for a particular application.

These new standards bear the numbers B.S. 3150, 3151 and 3152, the first of which covers ethanediol or ethylene glycol, inhibited with triethanolammonium orthophosphate and sodium mercaptobenzothiazole. This formulation was developed for aircraft piston engines, and is the subject of Ministry of Supply specification DTD 779. B.S. 3151 deals with ethanediol inhibited with sodium benzoate and sodium nitrite, which is a formulation based on work carried out by the Chemical Research Laboratory, now the National Chemical Laboratory, of the D.S.I.R.

The third Standard covers ethanediol inhibited with sodium tetraborate, commonly known as borax, and this is a formulation widely used in the U.S.A. Copies of the three Standards are obtainable from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1. The price of the first two is 4s 6d each, while B.S. 3152 costs 4s.

Coder Suspension

Ingenious French System for Commercial Vehicles, Embodying Rubber Elements and Giving Progressive Action

ONE of the more interesting suspension arrangements exhibited recently on the Continent is the Caouflex system, a product of Etablissements Coder, of Marseilles and Paris. It is intended primarily for the rear bogies of articulated vehicles, of either the four-wheel or eight-wheel type, but it can equally well be applied to a single-axle layout. Basically, the system comprises a pair of trailing arms, each of which is pivot mounted below one of the side members of the chassis frame. The arms are interconnected by a transverse member and carry the axle assembly. A series of hollow rubber springs is interposed between each arm and the side member above it. Since the arms have an initial downward inclination from the side members, their movement towards the full bump position brings the springs successively into operation, giving a steeply rising rate. With a four-wheel or eight-wheel bogie, the wheel movement on one side is virtually independent of that on the other: the wheels on each side are mounted on the ends of a longitudinal beam freely pivoted, at its centre, below the trailing arm.

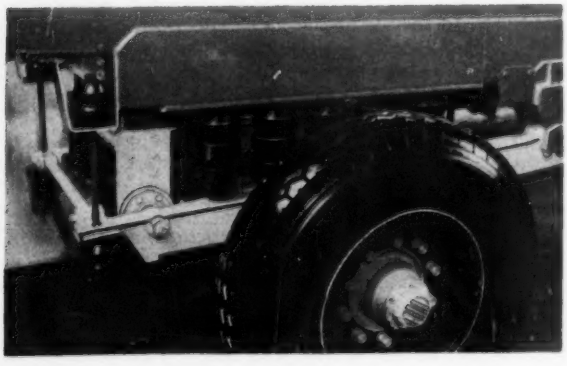
The trailing arms are of fabricated construction and box section, and each pivots in a rubber bushed bearing housed in a bracket below the chassis frame side member. This rubber mounting provides the necessary degree of flexibility to cope with deflection of the suspension on one side only. The interconnecting member between the arms is a large-diameter steel tube which, in the case of a two-wheel installation, serves as the axle.

To each side of the chassis frame, in line with the rear ends of the trailing arms, is attached a steel plate, mounted in the vertical, longitudinal plane. Against the outer faces of these plates bear circular pads, mounted in bosses in the arms. The pads are faced with a durable composition material, and they and the plates form a simple means of providing lateral location of the suspension assembly. To permit the wheels to be set in correct alignment relative to the chassis, the position of the pads relative to the arms can be adjusted: the spindles on which the pads are mounted screw into the bosses on the arms and are fitted with lock nuts.

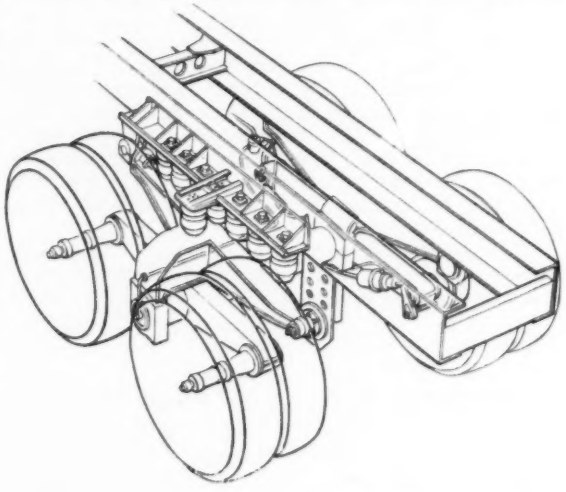
The hollow rubber springs are mounted on the underside of a long bracket attached to the outer face of each side member of the chassis frame. These springs are of relatively small dimensions, and their type and the number used depend on the individual layout and the loading involved. The lower abutments of the springs are the upper surfaces of the pivoted arms, and the geometry is so arranged that, with the vehicle unladen, the arms make an appreciable angle with the spring brackets, as viewed in side elevation; only the first two or three springs are then in use on each side: consequently, the effective spring rate is relatively low.

As the load on the vehicle is increased, or the wheels deflect on road bumps, the angle between the arms and the spring mounting brackets is reduced, and a progressively greater number of springs is brought into operation, thereby increasing the rate. At the full design loading, all the springs are in use. An indication of the progressive nature of the suspension is given by the following typical rate figures for a four-wheel bogie. With a load of ½ ton, the total spring rate is 2·04 ton/in; with loads of 1, 2, 5 and 10 ton on the bogie the rates are respectively 3·26, 5·92, 10·04 and 18·12 ton/in.

A Coder single-axle layout. The two trailing arms are inclined relative to the frame side members, to bring the springs successively into action



In the bogie application of the Coder suspension, the wheels are carried on stub axles mounted at each end of pivoted beams. Outboard of the rows of rubber springs are additional springs to increase the roll stiffness



The wheel stub axles of the bogie layout are rigidly mounted in the ends of longitudinally disposed beams, which are centrally pivoted and of box section. These beams oscillate on the interconnecting tube already mentioned, and the medial pivot boss of each beam houses two plain bearings. The bridge tube is clamped to the trailing arms by massive brackets, which provide support on both sides of each beam. An ingenious, automatic lubrication system has been developed for the pivot bearings: within the bridge tube is a quantity of oil, and the air space above it is in communication with the air outlet from the brake servo system. Thus, each time the brakes are applied, the oil is subjected to pressure, which forces it through ducts to the bearing surfaces.

A refinement of the suspension system is shown in an

accompanying illustration. It consists of two additional rubber springs carried, one on each side, on outrigger extensions from the middle of the main spring brackets. Since these extra springs are more widely spaced than the two rows of the main load-carrying springs, they add appreciably to the roll stiffness of the suspension. In the simple, two-wheel layout shown in the other illustration, each of the pivoted arms has a resilient rebound stop. This comprises two rubber springs, one positioned above an abutment on the chassis frame and the other below a second abutment, on the arm. The springs are mounted on a rod passing through holes in the abutments. Bump stops are provided by the main springs, which become solid on full compression.

Although its unsprung weight is relatively high, the Coder suspension system offers several advantages over more orthodox designs. It provides a considerable variation in spring rate with deflection, so that a satisfactory ride with the vehicle unladen is combined with the capacity to carry heavy loads. Adequate roll stiffness can be provided, and the wheel alignment is easily corrected if necessary. The basic units can readily be adapted to a variety of applications. Finally, the system is mechanically simple and robust, has a considerable safety factor by virtue of the multiple springs, and requires negligible maintenance during its service life.

Cellobond Resins

USEFUL technical information on the Cellobond range of adhesive and binder resins is given in a new data book published by British Resin Products Ltd. The book is divided into eight sections, each of which deals with a particular group of products in the range. Copies can be obtained from the Information Department, British Resin Products Ltd., Devonshire House, Piccadilly, London, W.1.

I.B.C.A.M. Annual Competition

DETAILS have recently been received, from The Institute of British Carriage and Automobile Manufacturers, of the 1960 Drawing and Handicraft competitions. These annual competitions are arranged by the Institute in conjunction with the Society of Motor Manufacturers and Traders, the National Federation of Vehicle Trades and the Worshipful Company of Coach Makers and Coach Harness Makers of London. Their purpose is to encourage younger people in the motor vehicle industry to improve their knowledge of body design, thus fitting themselves for positions of responsibility. The total value of the awards has been increased to £900 and, in addition, winners of first prizes will be awarded a free visit to a continental motor show. There are five drawing competitions and one for handicraft. Brief particulars of each are as follows.

Competition 1. A general arrangement drawing, in ink, to a scale of 1½ in to 1 ft, of a two-door, four-light, four-seater car, convertible from a closed to an open body by a hood, mechanically operated, with or without power assistance. The car should be designed for medium production quantities, on a 120 in wheelbase, and a 2½-litre engine.

Competition 2. A coloured drawing, and also an outline drawing, in ink, showing elevation and half plan, of a sports saloon of the 3½-litre class. The car should have two doors and should seat four persons; in addition, it should have good luggage accommodation.

Competition 3. An outline drawing, in ink, to a scale of 1½ in to 1 ft, of a four-door saloon of the station wagon type; seating arrangements should be indicated and dimensioned.

Competition 4. A general arrangement drawing, in ink and not shaded, of one only of the following types of body: single-deck service bus; double-deck omnibus; single-deck coach. The body chosen is to be mounted on a rear-engined chassis, a coachbuilder's chassis drawing of which will be supplied.

Competition 5. A general arrangement drawing, in ink and not shaded, to a scale of 1 in to 1 ft, of an all-steel, fully tropicalized and air conditioned three-man driver's cab, on a heavy-duty British tractor chassis. The cab should have two bucket seats facing forward, and a full-length transverse sleeping berth behind, for trans-continental operation; right-hand or left-hand steering.

Competition 6—Handicraft. Entries may be submitted of handicraft in any branch of the industry, including body-making, coach joinery and finishing, coach painting, trimming, panel beating and sheet metal work, sign writing and coach fitting.

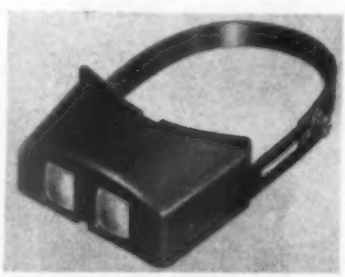
Full details of the various competitions, which are open only to persons of British nationality, are obtainable from The Institute of British Carriage and Automobile Manufacturers, 50 Pall Mall, London, S.W.1. The 1960 competitions will be the last of the series in the present form. Thereafter, the drawing sections will be divided into design competitions for automobile bodies and for public service and commercial vehicle bodies, to be held in alternate years. The Handicraft Competition will in future be known as the Motor Vehicle Body Crafts Competition, and will continue to be organized each year, as hitherto.

Management Consultancy

THE latest addition to the series of booklets published by the Management Consultants Association is entitled *Tomorrow's Managers*. Its title is indicative of the field covered by this booklet, copies of which are obtainable free on request to the Secretary of the M.C.A., the address of which is 4 London Wall Buildings, London, E.C.2.

Headband-Mounted Magnifier

MAGNIFICATION with good stereoscopic effect is provided by the new Ellis Headband Magnifier, intended for engineers, toolmakers and others whose activities demand the examination of minute detail. The lenses are accurately ground and give a magnification of 2¼ times at a focal distance of about 8 in; the field of view is large. Since the body of the magnifier is of lightweight plastics material, no discomfort is caused by long periods of wearing the unit.



The Ellis Headband Magnifier has a body of plastics material. Its magnification is 2¼ times at a focal distance of about 8 in

Extending over the top and sides is a hood, which shields the eyes from glare caused by the bright illumination of the object being viewed. The bottom of the body is open, to allow unrestricted downward vision, and the magnifier can be worn over normal spectacles. The manufacturers are the Ellis Optical Co., Mayday Road, Thornton Heath, Surrey.

Perkins Six 305 Engine

Six-Cylinder Power Unit, of 5 Litres Swept Volume, Intended for Commercial Vehicles

THE new Perkins Six 305 engine, first exhibited at the recent Scottish Motor Show, is a six-cylinder unit with a swept volume of 5 litres, and has been designed particularly for commercial vehicles. In its general design, the engine conforms with well established Perkins practice, but its specification includes thin-wall cylinder liners and a distributor type fuel pump. The bore and stroke, of 91·44 mm and 127 mm respectively, are identical with those of the C 305 underfloor engine and the Four 203 industrial unit, described in the November 1959 issue of *Automobile Engineer*. In fact, the Six 305 has several features in common with both these engines.

A single iron casting forms the cylinder block and crankcase, and the sump joint face is in the horizontal plane through the crankshaft axis. Aluminium is employed for the two-piece sump, the well portion of which is bolted to the underside of the main portion, at the front, and houses the suction pipe and strainer for the oil pump. All the cylinders except numbers 3 and 4 are siamesed. As on the other two engines mentioned, thin-wall steel cylinder liners are pressed into the block. To ensure long liner life, the bores are chromium plated.

The crankshaft, a forging of En.19T chromium-molybdenum steel, heat treated, is carried in seven steel-backed, copper-lead bearings. An oil thrower and an oil-return scroll are machined on the rear of the shaft. All journals are induction hardened, and the fillet radii of the rear main bearing are burnished rolled, to provide maximum resistance to fatigue. Location of the shaft is effected at the rear main bearing by steel-backed, lead-bronze thrust washers. Steel-backed, copper-lead lined bearings are also employed in the big ends, and the connecting rods are of En.17U manganese-molybdenum steel. The centre-to-centre length of the connecting rods is 9 in.

Wrapped, steel-backed copper-lead bushes are fitted in the small-ends. The gudgeon pins are fully floating and are retained by circlips in their bosses in the flat-crown pistons, which have a diameter : depth ratio of about 0·8 : 1. Each piston carries five rings: one oil control ring below the gudgeon pin, and another and three compression rings above it. A high-silicon aluminium alloy is employed for the pistons.

The timing drive, which is by a $\frac{3}{8}$ in pitch triplex roller chain, is enclosed by a die cast aluminium case and cover. To ensure durability, the crankshaft sprocket is of En.8 0·35 to 0·45 per cent carbon steel; the camshaft gear and the auxiliary drive gear are of high-duty cast iron. An automatic tensioner, of the ratchet type, maintains the adjustment of the chain. The V-belt pulley for driving the fan, water pump and generator is keyed to the front end of the crankshaft, and on the pulley is mounted the bonded-rubber torsional vibration damper.

As on several other Perkins units, the camshaft is carried high in the block, immediately below the head joint face. It is of high-duty cast iron, with chill-hardened cams, and runs in four bearings machined directly in the block casting. Cast iron is used also for the mushroom-head tappets, which have chill-hardened rubbing faces and operate in guides in the cylinder head. Because of the high camshaft position, the tappets directly actuate the fabricated rockers. Both contact surfaces of each rocker are hardened, as are the ends of the valve stems. For the inlet valves, En.18S chromium steel is employed, whereas the exhaust valves are of En.52 silicon-chromium steel; the valves are disposed vertically in the head and are closed by duplex springs. A pressed-steel cover encloses the rocker gear.

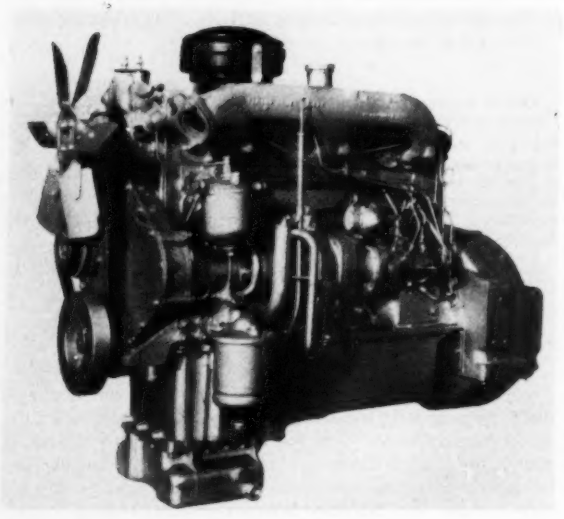
The cylinder head is of cast iron, and seats on a copper-asbestos gasket. In the head are formed the inner halves of the spherical swirl chambers, the outer halves being in detachable steel covers secured to the left side of the head. The combustion system is similar to that of previous Perkins engines, in that the injectors are vertical and direct the fuel into the necks between the swirl chambers and the cylinders; each nozzle has two sprays, one injected towards the cylinder and the other to the swirl chamber.

Fuel is delivered to the injectors by a C.A.V. DPA distributor type pump, fitted with a hydraulic governor. The pump is mounted in tandem behind the exhauster, which is driven from the auxiliary drive sprocket of the timing gear. A muff coupling connects the exhauster to the DPA pump. On the coupling is an eccentric that actuates the diaphragm type fuel lift pump. Adjustment of the injector pump timing can be effected by virtue of slotted holes in the coupling between the exhauster and the auxiliary drive shaft. The paper element fuel filter is mounted high on the right-hand side of the cylinder block.

Also on the right-hand side, on the cylinder head, is the induction manifold, which is an aluminium die casting. Provision is made for an air filter to be mounted on the riser of the manifold. The exhaust manifold is on the other side of the head; it is of cast iron and has a forward-facing, two-bolt outlet flange.

Lubrication of the Six 305 engine is effected by an eccentric-lobe type oil pump, bolted to the underside of the crankcase and driven by a vertical shaft from a spiral gear on the auxiliary drive shaft. A rubber sleeve encloses the vertical shaft between the auxiliary drive housing and the crankcase.

The C.A.V. distributor type fuel pump of the Perkins Six 305 engine is mounted horizontally and is driven in tandem with the exhauster

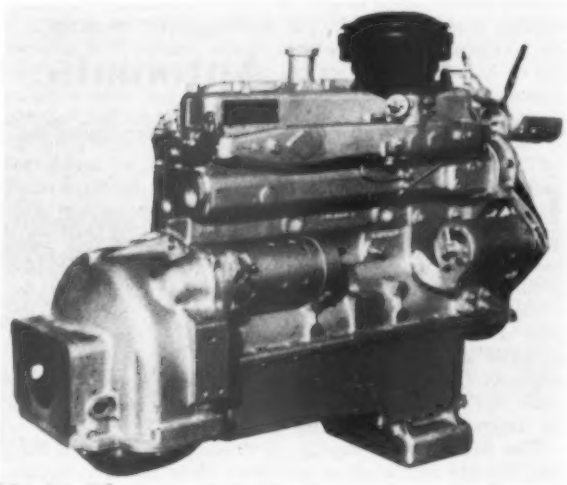


The strainer on the inlet side of the pump is suspended in the sump, by two supports, so that it is always higher than any sludge that might be deposited on the sump floor.

From the pump, the oil is delivered through internal ducts to the relief valve, and thence by external piping to the main oil filter, of the paper element type. A second external pipe leads to the main, longitudinal oil gallery, drilled in the crankcase casting. Lateral passages through the main bearing webs take the oil to these bearings; the big-ends are fed in the usual way, by drilled ducts in the crankshaft. Other pipes carry the oil from the filter to the auxiliary drive housing and to number 2 camshaft bearing, from which it is metered intermittently to the hollow rocker shaft. A further oil feed is taken to the exhauster and to the eccentric for the fuel lift pump, whence it drains through an external pipe to the crankcase. The oil and air that are discharged from the exhauster unit are also led into the crankcase.

Oil from the rocker gear drains down the tappet guides into a trough, below the camshaft, cast integrally with the crankcase; this oil lubricates the cams and numbers 1, 3 and 4 bearings of the camshaft. The level in the trough is controlled by a weir, over which the oil flows into the timing case, to lubricate the chain. This supply is augmented by spill from the front main bearing and from the bearing of the auxiliary drive shaft. The cylinder bores, small-end bushes and gudgeon pins are lubricated by splash from the big-end bearings. An oil pressure gauge connection or a warning switch can be tapped into the main delivery banjo on the filter.

Alternative positions for the centrifugal type water pump are on the front of the cylinder head or on the timing gear front cover, according to installational requirements. The pump has curved blades to reduce the likelihood of cavitation at high speeds. A thermostat is fitted to its outlet, and the six-blade cooling fan is mounted in front of the driving belt pulley. From the thermostat, the water flows along a fabricated gallery with three branch outlets to the left-hand side of the cylinder head; the block is cooled by thermo-syphon effect. Provision is made for the fitting of heater connections and a thermometer bulb.



Features of the new Perkins unit are swirl type combustion chambers, thin-wall cylinder liners, and a high mounted, chain driven camshaft

The mounting of the 12-volt generator has the usual slotted link arrangement for the adjustment of belt tension. A starter motor can be supplied, for flange mounting on the flywheel housing. Should an air compressor be required instead of an exhauster, it is installed in the same position, ahead of the fuel injection pump. Cold starting of the engine is facilitated by the fitting of a Thermostart heater; this is installed mid-way along the inlet manifold.

Tyre Materials

AT THE Institution of the Rubber Industry, Dr. A. Schallamach, of the British Rubber Producers' Research Association, recently gave a lecture entitled "How Tyres Work". In this lecture, he compared the economics of natural and synthetic rubbers for car tyres. His conclusion was that natural rubber had the advantage because, although it might wear a little more quickly in certain conditions, its power absorption—and hence the fuel consumption—was lower. On a basis of first cost against useful mileage, the synthetic rubber tyre might show a saving of about 15s. However, during its life, it might well have necessitated the expenditure of £7 more on petrol than would the natural rubber type. This lecture was based on a series of investigations carried out during the last three years by Dr. Schallamach at the B.R.P.A. laboratories.

Leyland Worldmaster Hand Brake

TO GIVE greater efficiency, power assistance is now available for the handbrake operation on the Leyland Royal Tiger Worldmaster passenger chassis. The existing mechanical linkage for the handbrake is assisted by means of an air servo unit of the diaphragm type, mounted on a main cross member of the chassis frame. Air pressure at 65 lb/in^2 is applied from the auxiliary reservoir, the supply from which is controlled by a valve actuated by the handbrake linkage.

In the unlikely event of failure in the air servo system, the mechanical actuation of the handbrake is unimpaired; the footbrake is, of course, operated by means of an independent pneumatic system. A measure of the effectiveness of the power assistance is given by the retardation efficiency of 27 per cent obtained with a lever pull of only 33 lb. Without the servo, a pull of 100 lb gives a lower efficiency.

Colloidal Dispersions

COLLOIDAL dispersions of graphite and molybdenum disulphide are now widely used in the automobile industry for lubrication of parts on assembly, as anti-sieze coatings and for the impregnation of components on manufacture. A leaflet entitled "Colloidal Dispersions", and describing the range and application of Foliac products of this type, has recently been issued by Graphite Products Ltd., a subsidiary of The Morgan Crucible Co. Ltd. Copies are obtainable from Graphite Products, the address of whom is Northfields, Wandsworth Park, London, S.W.18.

Information on Sparking Plugs

A BOOKLET entitled "Spark Plugs—What They Are and How They Work" has recently been published by Lodge Plugs Ltd., of Rugby. Intended to meet the requirements of technical schools, evening classes and car and motor-cycle clubs, it describes briefly the functioning of the internal-combustion engine, and then covers in more detail the various factors governing the design and performance of plugs. The publication has the reference number SP15, and copies are obtainable from Lodge Plugs Ltd. on request.

Automatic Shear Lines

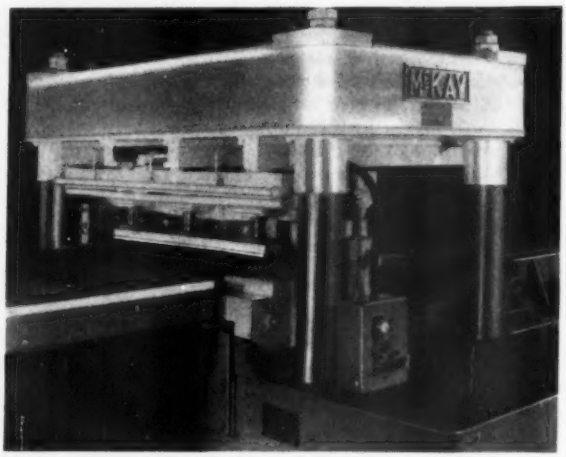
British-built McKay Equipment for Coiled Material of Widths up to 72 in.

INCREASING use is being made of coiled sheet material instead of cut sheets from the rolling mill, and this trend has led to the development of integrated lines for the production of levelled and sheared press blanks in the workshop. On conventional equipment for this work the feed is intermittent and a looping pit or other device to maintain an approximately even tension on the feed rolls is required. The provision of the necessary floor space for such equipment may present difficulties in some shops or in conjunction with existing press lines.

The McKay Machine Co., of Youngstown, Ohio, U.S.A., has recently developed an automatic shear line that uncoils, levels, and cuts to blank length in a continuous sequence of operations, and does not need to be slowed or stopped even when changing the sheet length. An uninterrupted flow of material is made possible by the elimination of any build-up of sheet against the shear, since the cut is effected whilst the die is in motion at precisely the same speed as the material. McKaymatic Die Shear Lines are currently being built by Vickers-Armstrongs (Engineers) Ltd. at Newcastle, and the selling agent for this British-made equipment in the United Kingdom is the Rockwell Machine Tool Co. Ltd., Welsh Harp, London, N.W.2.

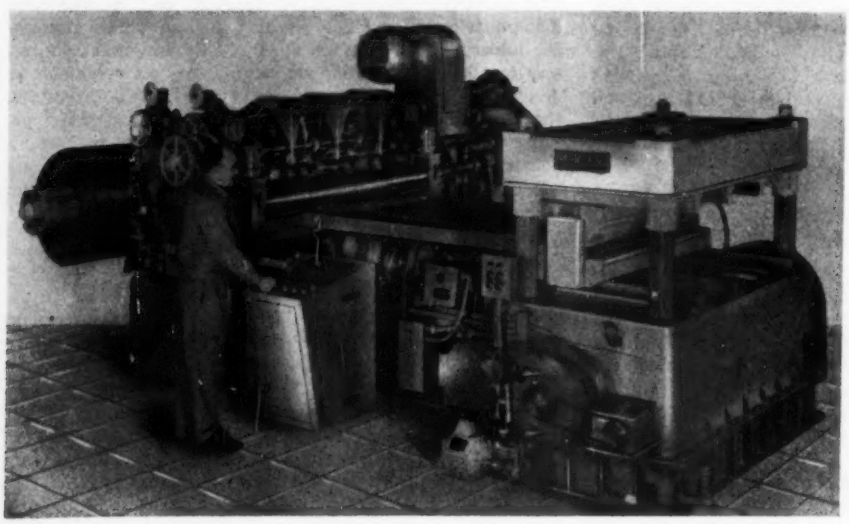
Shear lines are built to handle material of widths up to 72 in and most thicknesses. Sheets 4 ft long or over can be cut at the maximum line speed of 200 ft/min but shorter lengths require proportionately lower speeds. The production of sheets only 9 in long is possible at the minimum line speed of 30 ft/min. Electronic measurement and control devices maintain the sheet lengths within very close tolerances and make possible the volume output of sheets of different lengths, since the sheet length can be changed instantly without halting the line. Slitting rollers can be incorporated to trim the material to precise width.

Equipment to produce blanks of the exact length required effects substantial economies when compared with the use of cut sheets. Coiled material is less costly than sheet material, special sizes do not entail extra expense, waste is reduced to a minimum, and stock material is less susceptible to damage in transport or in storage. An automatic, continuous-flow line offers further advantages over an intermittent-flow line; higher rates of production, no loss of time when changing sheet length, and the need of much less floor space.



The 35-ton, under-drive, four-column, shear press, with travelling die, is driven by an A.C. motor. Notching and piercing of the sheet adjacent to the shear cut can be effected simultaneously

Coil holders of the cone type with capacities up to 25 tons are available and mechanical coil-loading equipment can be supplied. Presses and roller levellers are varied in design and dimensions to meet specific requirements. Since there is no looping or humping to set the material, the need for secondary levelling is eliminated. In the line illustrated, handling material up to 48 in wide and 10 S.W.G, is a 5 ton



This McKaymatic die shear line handles coiled stock up to 48 in wide × 10 S.W.G. Sheets over 48 in long can be cut at the maximum material speed of 200 ft/min. Shorter sheets are sheared at proportionally lower linear speeds, down to the minimum of a 9 in sheet at 30 ft/min

capacity, expanding-mandrel type, pay-off reel with drag brake and threading drive, and a 17-roll, triple backed-up leveller.

The 35-ton press is an under-drive, four-column, two-point suspension unit with pneumatic clutch, and brake. For ease of maintenance, A.C. driving motors and controls are used in conjunction with mechanical speed variation. No speed matching of line components is necessary as regulating loops and variable speed drives are not used. Standard equipment includes a pneumatic hold-down bar and counterbalances. Should notching or piercing need to be done near the shear cut, the necessary tooling can be installed with the cut-off blades.

During a cutting cycle the die accelerates to the linear speed of the material, effects the cut, and returns on anti-friction bearings over hardened guide rails. Synchronization of the die with the moving material precludes the possibility of strip damage, such as can occur with mechanical length gauging in conventional arrangements.

Control of the travelling die motion is by a surface measurement system which includes a pulse generator on the exit pinch rolls. When the die has accelerated to the material speed and reached the required position for cutting the selected length, a signal from a counter unit triggers the cutting action. Simultaneously, this signal is used as the datum for measurement of the succeeding sheet. The traverse of the shear die is 18 in. Of that distance about 2½ in is required for acceleration to line speed, about 12 in is available in which the cut can be made, and the remainder is required for deceleration.

The operator determines the length of the cut sheet and the batch quantity by means of push buttons on the control console. Automatic programming, using either data-processing cards, punched tape, or a series of manually preset length and quantity selectors, is available as optional equipment and can be adapted to meet specific requirements.

Electric Eraser

NOW available in this country is the American Sanford Auto Erase, battery operated electric eraser, which removes pencil, ink or typing. It relies on speed of rotation rather than pressure for its effectiveness; because of this, there is no need to protect carbon copies. The small size of the actual eraser portion enables single characters to be deleted without the use of a shield.

The Auto Erase unit is small, light and conveniently shaped for holding. Also, the lead from the combined battery case and storage box is long enough for convenient operation on the desk or drawing board. The box contains two standard torch batteries, which are claimed to be adequate for several months' use. Alternative erasers are supplied for pencil, ink or type work. The Auto Erase is marketed by Badenia Calculators Ltd., Lion House, Red Lion Street, London, W.C.1., from whom further details and the price of the device are obtainable on request.

The Sanford Auto Erase, a compact battery operated electric eraser

Bus Washing Plant

AN INTERESTING, fully automatic machine for bus washing has recently been introduced by the London Transport Executive at its Harrow Weald garage. It requires only one man in attendance and is the prototype of a design that will be followed, at other garages, for all new washing installations. It is estimated that, in a garage operating 100 buses, and taking into account both regular night servicing and special periodic washing, the manpower saving is of the order of six men.

The complete cycle takes about four minutes. While the vehicle is being refuelled, its interior is suction cleaned, and it is then driven to the washing plant, which is near the fuelling point. The passage of the vehicle into the first station of the washing plant, which is between guide rails for transverse location, interrupts a light beam directed on to a selenium cell. This causes relays to be actuated, one of which turns on the water to a longitudinal overhead pipe. While the water from this pipe rinses the roof, the operator brushes either the front or the back of the bus—these ends are done on alternate days.

After a predetermined interval, long enough for the end brushing to be completed, the overhead water supply is turned off. Simultaneously, the brushes and water sprays are brought into action in the washing machine, situated a few yards further ahead. As soon as he sees the machine start, the driver moves the bus forward to it. This movement causes the roof to be cleaned by a stationary felt squeegee, shaped to the correct contour. The efficiency of this squeegee is such that rotary brushes are unnecessary.

In the washing machine, which at the Harrow Weald garage is a Februat unit, each side is cleaned by a vertical row of horizontal water jets used in conjunction with rotary brushes of nylon, the jets being sited immediately before the brushes. A second set of jets gives a final rinse after the scrubbing has been completed. The standard machine has been modified by the addition of two brushes on each side. These extra brushes improve the cleaning of the lower portions of the sides, which are liable to become caked with dirt in wet weather.

The bus is driven slowly through the washing machine, and this is automatically switched off after a pre-set time has elapsed. On emerging from the machine, the bus is moved to its parking position, and its place is taken by the next bus which, to minimize delay, is already drawn up in front of the plant. For special purposes, the operation of the plant can be switched from automatic to manual control; also, the timing of the relays for the automatic control can be varied to suit the conditions at individual garages.

Nash and Thompson Ohmmeter

UNDER the heading "Test Equipment", in the October 1959 issue of *Automobile Engineer*, a description of a new ohmmeter was given. This instrument is manufactured by Nash and Thompson Ltd., Oakcroft Road, Chessington, Surrey. The range of the instrument was incorrectly quoted: in fact, it will measure resistances between 10 ohms and 10,000 M ohms, in eight ranges, to an accuracy of ±3 per cent of the reading that is being taken.

THE COLD WORKING OF STEEL

Phosphate Coatings Found to be the Sole Commercially Practicable Type of Lubricant for Severe Deformation Processes

FOR a long time phosphate coatings have been used for the rustproofing and paint-bonding of metals and, more recently, as an aid in wire-drawing and tube-drawing operations. Only in the last few years, however, have coatings of this type been employed in Britain to assist generally in processes for the cold deformation of metals. In deep drawing, phosphate coatings are now being used to enable the severity of draw to be increased and the number of draws to be reduced. In cold extrusion, phosphate coatings are allowing processes to be carried out which, because of the excessive deformation involved, would otherwise be impossible.

An increasing application of the cold-extrusion technique, in particular, to a variety of steels and shapes, indicates its commercial value where high-quality output is required. Substantial savings in material, machinery and manpower; enhanced physical properties; reduction of inclusions and porosity; and the possible elimination of heat treatment are the chief advantages of the cold-extrusion process. The increase in severity and the reduction in number of draws made possible by the use of phosphate coatings in deep-drawing operations are of similar importance.

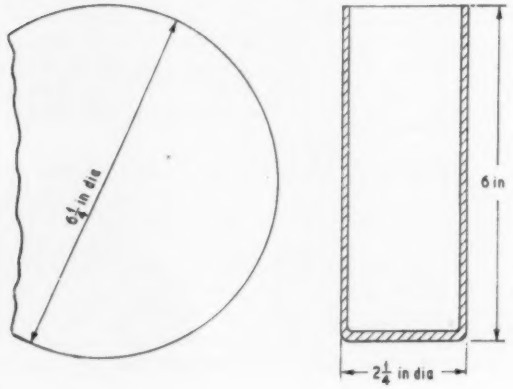
The types of steels that can be treated by phosphating for lubricating purposes are the low-, medium-, and high-carbon steels and also alloy steels having ferritic structures. Before considering the types of phosphate coatings available and the functions they perform, however, it is desirable to indicate briefly the ways in which such coatings act as lubricants.

Lubrication requirements

All metal deformation processes that involve either pulling or pushing a blank of metal into or through a die of some kind have to overcome friction of two types. The work to be done to overcome internal friction of the metal being deformed is entirely a function of the characteristics of the metal and the die shape and cannot be reduced by any lubricating treatment applied at the surface of the metal. Work that is required to overcome friction at any surfaces at which sliding occurs between the blank and the die or the punch, obviously, can be influenced by lubrication. In pure forming, for example, the frictional forces to be overcome are almost entirely internal, but some percentage of "ironing" must always occur in practice, so that some advantage from lubrication will be derived. Where the deformation process involves a considerable amount of ironing or thinning, however, lubrication is essential.

An outstanding method of lubricating is by means of a phosphate coating, although oils, extreme-pressure lubricants, and metal coatings have often been used in the past. Phosphate coatings not only possess valuable lubricating properties themselves but also act as absorbents for soaps—combinations of fatty acid and a metal such as aluminium, sodium, or calcium—to provide a type of lubrication that is particularly effective in drawing, cold-shaping, or cold-extrusion processes where very high unit pressures are necessarily encountered.

This deep-drawn cup is produced from a circular blank, 6¼ in diameter by 0·055 in thick, in one operation. A phosphate coating weighing 2,700 mg/ft², Walterisation DXL process, and subsequent impregnation with DX lubricant, is used. Components of this type cannot be produced in a single operation with the aid of a phosphating process



General process details

Before phosphating, the parts must be free of grease, rust and scale. Degreasing is best carried out by a suitable alkaline cleaner. Sulphuric or hydrochloric acid pickling should be employed for removing any rust or scale that is present. Pickling is frequently necessary to produce the desired type of phosphate coating, and may be used for this specific purpose where rust and scale are non-existent. Specially formulated pickles have been devised to produce the very heavy coating weights required on steel which is subsequently to be extruded. If an inhibitor is incorporated in the pickling bath, extreme care is necessary to ensure that the properties of the subsequently formed phosphate coating are not adversely affected.

Very thorough rinsing is necessary after degreasing and pickling to ensure freedom from carry-over into the next processing tank. The cleaned work is then immersed in the phosphating solution at the appropriate strength and temperature for the time necessary to produce the required coating. For deep drawing, coating weights of 300 mg to 2,000 mg/ft² are usual, with coating weights up to 2,750 mg/ft² for particularly severe applications. For extrusion, coating weights range from 1,300 mg to 4,500 mg/ft². The phosphating process must be one which will produce the type of coating that is specifically suited to the metal deformation process as regards adherence of crystal, and ease of transformation to the glass condition during drawing or extrusion. After rinsing, the secondary lubricant is applied.

During the first draw or extrusion, the phosphate coating becomes converted to a glassy, amorphous film which is a better lubricant than the original crystalline coating. It is not advisable to attempt further drawing if the glass coverage is not complete, or at least virtually complete, over the metal surface. As an example of the degree of elongation that is possible, experiments with radiophosphorus have shown that as much as 89 per cent of a zinc phosphate coating was retained on artillery shells during a 38 per cent elongation

by cold extrusion. During deformation, the phosphate coating possesses plastic properties and elongates with the base metal.

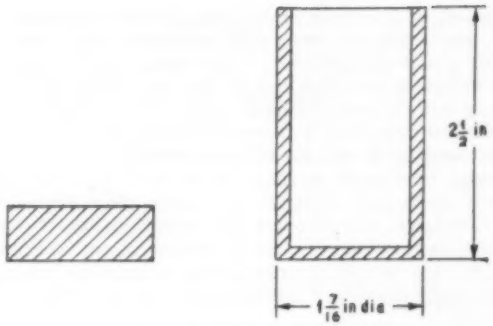
Deep drawing applications

Until recently, very heavy deformation of sheet steel was only possible by techniques involving many drawing operations and interstage annealings, because sheet steel cannot accommodate the excessively heavy stresses otherwise involved. The use of phosphate coatings impregnated with secondary lubricants, however, reduce surface friction and consequent work hardening and thus permit the greater deformation involved in modern presswork. This also allows some of the interstage annealing to be omitted and results in improved surface quality of the drawn components and in considerably prolonged tool life. High drawing speeds and improved physical properties of the worked material are other advantages.

It is not always necessary to use deep-drawing quality steel, since ordinary low-carbon steels when phosphated and lubricated are often of sufficient quality. In this way, cheaper raw materials, or those that normally would not be completely suitable for the process, can often be employed. Large reductions—85 per cent in some cases—can be accomplished in several stages before re-phosphating is necessary. The limiting factor is the need for annealing when excessive internal stresses have been produced. Pickling and re-phosphating would then be necessary.

Phosphate coatings find particular application in deep-drawing, cupping, coining, heading and necking. In these operations, phosphating is usually helpful, and becomes more beneficial as the severity of deformation is increased. Phosphate coatings can thus make possible a reduction in the number of stages required to produce the finished component, or allow interstage annealing to be omitted, or both.

In general, light phosphate coatings—within the range of 300 mg to 2,000 mg/ft²—are used in conjunction with lubricants for assisting in deep-drawing and cold-shaping processes where the degree of deformation to be achieved in any one operation is not particularly severe. The phosphating process used should be designed and selected to give the necessary coating weight as the result of treatment for approximately ten minutes. After phosphating, parts should be rinsed thoroughly, preferably in cold water and then in hot, running water. Drying before applying the lubricant is desirable but not essential, although rinsing and drawing must be sufficiently thorough to avoid dilution of the lubricant bath by excessive carry-over of water. In some cases, it has been shown that it is not necessary to dry the lubricant before the forming process.



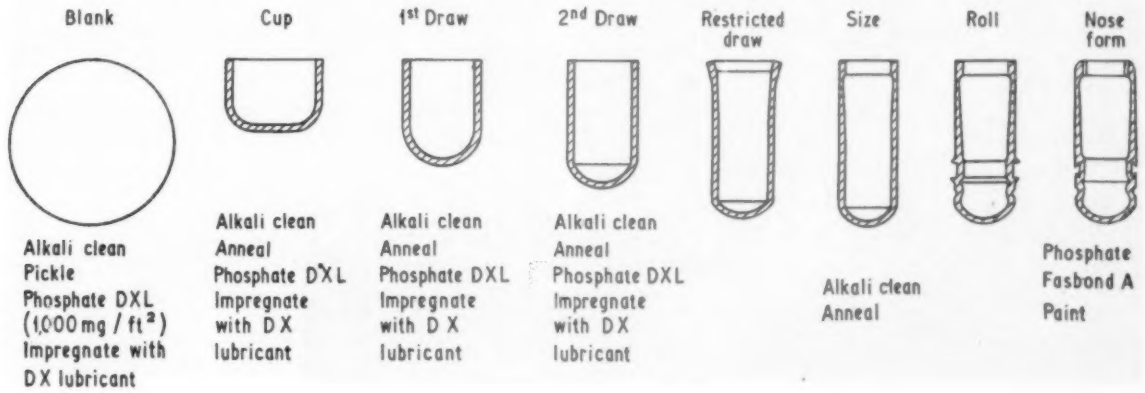
Typical cylindrical cup, cold formed by the back extrusion method in one operation. The slug is treated in the Walterisation DXH process, after degreasing and pickling, to give a coating weight of over 3,000 mg/ft² which is then impregnated with a DX lubricant. Phosphate coating is an essential in such operations

Extrusion applications

In cold extrusion, a suitable billet of steel—usually bar stock of up to 3 in diameter—is loaded in compression between a die and a punch until the stresses induced in it exceed the elastic limit. The billet then deforms plastically and is extruded either forwards though the die or backwards between die and punch. In such operations, pressures in excess of 350,000 lb/in² may be necessary. Without the use of phosphate coatings for lubrication, unit pressures required would be so high that the operation would be impossible: welding would occur between workpiece and tools, causing punches to fracture or the workpiece to rupture and fail to flow smoothly. It should be emphasized that phosphating is the only type of lubricant which, under commercial conditions, has been found to be practicable and to permit these very severe deformation processes.

In forward extrusion, the extruded part moves in the same direction as the punch; in backward extrusion, a process similar to piercing for converting solid billets into cups is carried out. Forward and backward extrusion can be

Operational sequence for the production of a 30 mm shell. The use of the Walterisation DXL phosphating process in conjunction with DX lubricant has enabled this sequence to be performed with considerably improved standard of surface finish and extended tool life with, at the same time, a reduction in the percentage of rejects. A similar sequence is also being used for the production of this type of shell on transfer presses. This is made possible by the use of the Walterisation DXH process to provide a coating weight in excess of 2,000 mg/ft² on the blank, and with an increased concentration of DX lubricant. As a result it has been possible to eliminate all interstage annealing and subsequent surface treatment. This is an extremely interesting and novel application since, although production of items in light-gauge steel on a transfer press is well established, the use of such techniques for heavy-gauge articles is believed to be unique. (By courtesy of Wilmot Breeden Ltd.)



combined, or it is possible to make the first operation hot and then follow on with cold extrusion after cleaning, descaling and phosphating. Some typical applications for cold extrusion processes include the production of needle bearing bushes from a blank in a single stage, of shells from pre-formed cups, and of magnet housings for loudspeakers. Other parts produced by cold extrusion include air hammer housings, telescoping housings for the front forks of motor cycles, telescoping cylinders for shock absorbers, starter gears, hydraulic valve tappets, gear wheels and drive shafts.

Phosphate coatings for use in conjunction with lubricants in cold extrusion, or in severe metal deformation processes where more than one forming operation is required without interstage annealing, are normally of the heavy type—within the range of 1,300 mg to 4,500 mg/ft^2. Before phosphating, the slugs or blanks must be degreased, descaled and generally prepared for the phosphate treatment as already described. In sequence, the full process will normally be as follows:

1. Degrease; 2. water rinse; 3. acid pickle; 4. water rinse; 5. water rinse; 6. zinc phosphate; 7. cold water rinse; 8. hot water rinse; 9. apply secondary lubricant; 10. dry.

Acknowledgment is made to R. F. Drysdale, A.I.M., a technical director of the Walterisation Co. Ltd., Croydon, Surrey, for the specialist information on which this article is based, and also to Wilmot-Breeden Ltd., of Birmingham, 25.

Four-Axis Die-Sinking Machine

Development of the Keller Machine to Speed the Production of Warped Surfaces

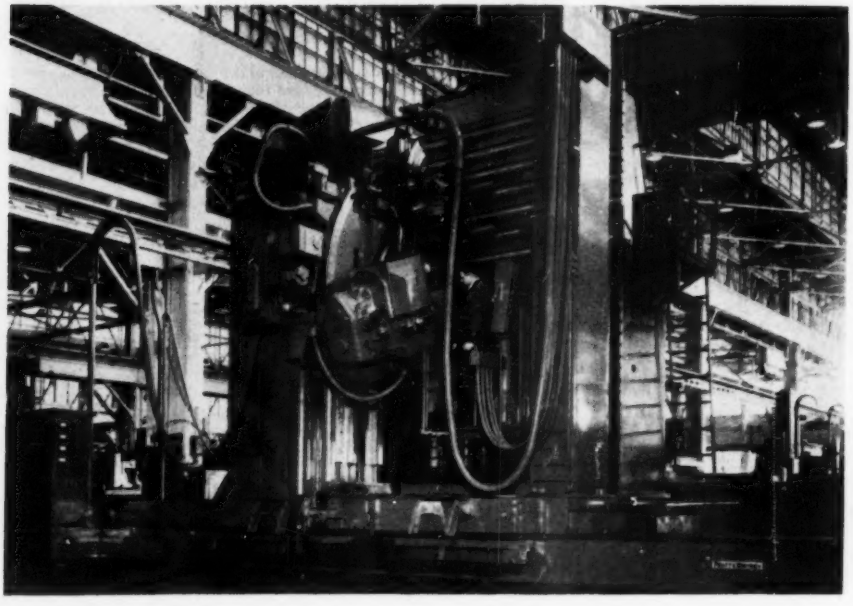
BUILT by the Pratt and Witney Co. Inc. in the U.S.A., this new Keller machine represents a further development of the BG-22 model which is widely used for the production of large dies for body pressings. It can perform all the functions of the three-dimensional machine with equal facility but the provision of a special tilting milling head enables it to develop so-called "warped" contours more expeditiously than was possible hitherto.

The head tilts about an axis arranged parallel to the direction of longitudinal motion of the machine and has a range of movement over 20 deg above and 20 deg below the horizontal. A template mounted on the vertical table of the machine and parallel to the longitudinal motion presents a rise-and-fall profile to a roll-type follower that controls the angle of tilt of the head through a servo mechanism.

Prior to the development of the new machine, dies for components having warped surfaces were produced on a three-dimensional machine and entailed a large number of milling passes. The tilting-head machine has already proved its ability to reduce machining times, to improve the quality of surface finish, and to reduce the time required for the hand finishing of warped shapes. An unusual feature of the machine is the location of the operator's control panel. This is mounted on an electrically powered elevating platform which enables the operator to select the most advantageous position to view the work in progress.

Machines are built with a horizontal travel of 10 ft, 12 ft, or 14 ft. Vertical and transverse travels are standardized at 48 in and 15 in respectively. Normal spindle speeds are from 30 to 1,800 rev/min in fourteen steps. Optional ranges are 15-900, 20-1,200, and 25-1,500 rev/min, the drive in all cases being by a 30 h.p. motor. A special high-speed spindle with speeds from 60 to 3,600 rev/min is also available. This, however, at speeds below 1,800 rev/min, can only be used at a reduced horse-power.

The sole agent for Keller machines in the United Kingdom is Alfred Herbert and Co. Ltd., of Coventry.



Keller die-sinking machine with tilting, tracer-controlled milling head, specially developed for the generation of warped contours on large punches and dies. Control is exercised from a panel on the lift platform which enables the operator to keep the work in progress continuously under observation

Deburring Pump Drive Gears

Roto-Finish Barrelling Operation Interposed Between Hobbing and Shaving Stations in Vauxhall Production Line

CAMSHAFTS for Vauxhall four-cylinder and six-cylinder engines are of cast iron and are chill-hardened on the cam faces. The integral oil pump drive gear on each shaft is hobbed and shaved at a late stage in production, after oilways are drilled and cam profiles and shaft journals are finished. It was found that burrs remaining on the drive gear after hobbing could impair the efficiency of the subsequent shaving operation and could even lead to damage of the cutters. As a consequence, it was decided to deburr the gears prior to shaving.

To obtain a consistent result at the requisite production rate without undue expenditure of manpower, barrelling was selected as the method to be employed. Roto-Finish Ltd. were consulted and an installation to meet requirements, and that could be accommodated in space available alongside the main production line, was planned. The barrelling operation consists of a treatment of one hour duration at the relatively low speed of 19 r.p.m., with a mixture of specially developed abrasive media and barrelling compounds in water to a predetermined level in the barrel. It is not intended that the operation should radius the edges of the cam profiles; in fact, the only effect is to slightly reduce the sharpness of these edges. An incidental advantage of the process, however, is that a good, oil-retentive, surface finish is imparted to the faces of the cams.

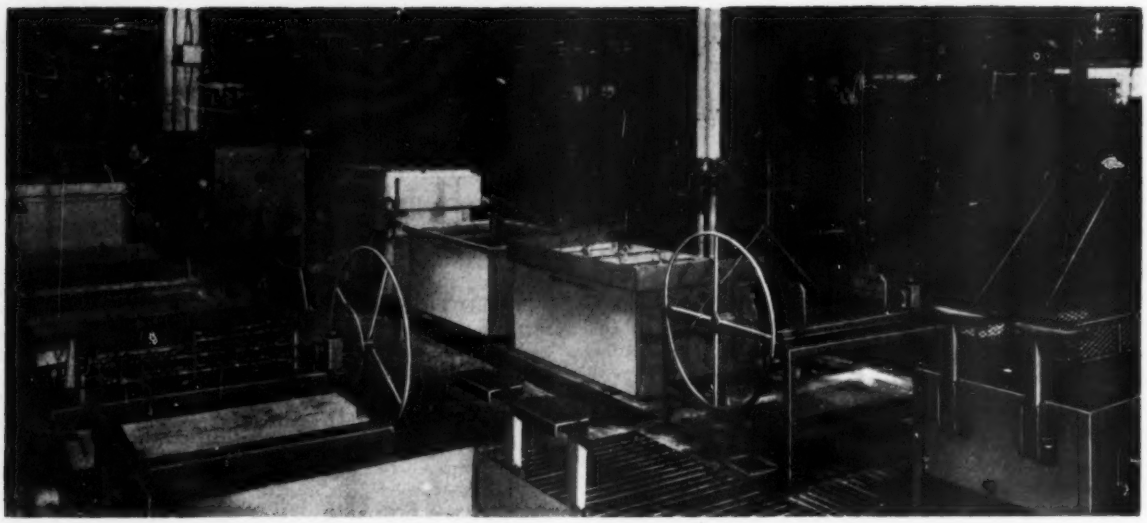
The installation comprises two parallel processing lines, one for four-cylinder camshafts and the other for six-cylinder camshafts. Apart from the jigging arrangements for the two different components, the equipment in each line is identical, consisting of a Roto-Finish barrelling machine, cold water rinse tank, sodium metasilicate degreasing tank, turnover-type jigging bench, and dewatering oil tank. The barrel of the machine is fitted with four special, full-width lids, each incorporating on the underside a jig to position and secure the camshafts. A duplicate set of these combined lids and jigs is provided to enable jig loading to be effected on one set while the other set is processing. Electric hoists on an overhead runway, by G. W. King Ltd., are used to handle the loaded jigs into or out of the barrel and to transfer them from tank to tank on the line.

Operations are sequenced as follows. Camshafts are taken from the hobbing machine to the jigging table and loaded on an inverted lid. Sixteen four-cylinder shafts are carried on each jig for one line and eight six-cylinder shafts on each for the other line. To prevent grinding chips or barrelling debris gaining access to the oilways of the camshafts, band-type clips are sprung around the centre bearings. A rubber fillet, forming a permanent part of the jig structure, masks the oilway in the rear end bearing. The loaded jig is turned over, picked up by a chain sling on a hoist, and then transferred to the sodium metasilicate tank for the degreasing of the shafts. Following a cold-water rinse, the loaded lid is lowered into the barrel and clamped in position.

After processing for one hour, the lids are hoisted from the barrel and the camshafts are given a cold-water rinse and a dip in the dewatering oil. They are then returned to the jigging table for unloading, whence they are passed to the shaving machine. One operator only is required to run

Camshafts taken directly from the hobbing machine are racked alongside the barrelling line. From the rack the shafts are loaded on to a jig on the underside of a barrel lid, supported on a turn-over fixture

A barrel lid complete with jig loaded with four-cylinder camshafts being lowered into position. There are four such lids to each barrel. At the front of the barrel is shown a lid clamped in position



Twin barrelling lines for four-cylinder and six-cylinder camshafts, left and right respectively. At centre rear, between the Rotc-Finish barrelling machines, is a storage bin compartmented to hold grinding chips of two different sizes

the two processing lines. Complete cycle time—loading, barrelling and unloading—is 1 hr 20 min. In this period, 64 four-cylinder shafts and 32 six-cylinder shafts are treated. At the Vauxhall plant an 8½-hour shift is worked, enabling six processing cycles to be carried out each shift. Thus the throughput is 384 four-cylinder shafts and 192 six-cylinder shafts per shift when working at full capacity.

At the end of each shift 30 minutes are allowed for flushing out the compounds from the barrels and cleaning. Grinding chips remain in the barrel until such time as they are worn beyond permissible limits. Chips for replenishment are stored in a bin located at the end of the lines.

High-Density Polythene

APPLICATIONS for plastics materials to cars and commercial vehicles are likely to be increased by the introduction of high-density, or rigid, polythene. Ordinary polythene, or polyethylene, to give the correct chemical name, is largely amorphous and of a waxy nature. In contrast, the high-density material is highly crystalline, and is therefore harder and much more rigid. It can be moulded, extruded and cast by conventional methods, and also lends itself to foaming, welding and flame spraying.

Owing to its resistance to solvents, high-density polythene can be used in brake fluid reservoirs, or for valves, piping and taps for petrol, paraffin and other hydrocarbons. Its rigidity makes it suitable for applications such as ducting for heating and demisting equipment. As an insulator for electric cables, the high-density polythene has the advantages of excellent electrical resistance properties, a high softening point, toughness over a wide temperature range, and good abrasion resistance. Yet a further possible use is for upholstery fabrics, for which the monofilament and multifilament forms are suitable. Fabrics woven from this material are strong and washable; they resist abrasion, and staining by oil or grease.

Much interesting and useful information on the properties and applications of high-density polythene is given in a booklet published by British Resin Products Ltd., one of the country's leading suppliers of this material. This 20-page booklet, entitled "Rigidex—the Polythene Plus", is unusually well produced; copies can be obtained on application to the company, the address of the head office of which is Devonshire House, Piccadilly, London, W.1.

Commer Engine Improvements

IMPROVEMENTS have been made to the 1,494 cm^3 engine and the gearbox of the Commer Express delivery van. The engine has now been brought up virtually to the specification of the 1959 Hillman Minx car unit, by the fitting of more efficient inlet and exhaust manifolds. Also, a Zenith 30 VIG carburettor has been adopted which is said to give, with this engine, more economical part-throttle cruising than did the instrument previously employed. The air filter is now of the AC paper element type. As a result of the changes, the power output has been increased to 52·5 b.h.p. at 4,600 r.p.m. and the maximum torque to 75 lb-ft at 2,000 to 2,200 r.p.m.

The gearbox has been replaced by that installed on all the Rootes 1960, 1½-litre cars, except those with the Smiths automatic transmission, and on the Humber Hawk models. This latest gearbox has a considerably better spacing of the ratios than was given by the earlier one. The operation of the steering column gear change has been inverted, to conform with more common practice: the first and second gear positions are now in the upper instead of the lower plane.

Spray Deposition of Metal

IN THE October issue of *Automobile Engineer*, the Sprabond Wire process for the deposition of metal was described. This bonding process is the subject of British Patent number 692185, and Metallizing Equipment Co. Ltd. is the registered user of the trade marks METCO and Sprabond Wire. The company is at Chobham, Woking, Surrey.

AUTOMATIC OPERATION OF CAPSTAN LATHES

Nickols Equipment for the Conversion of Existing Standard Machine Tools to Fully Programmed Control for Small Batch Production

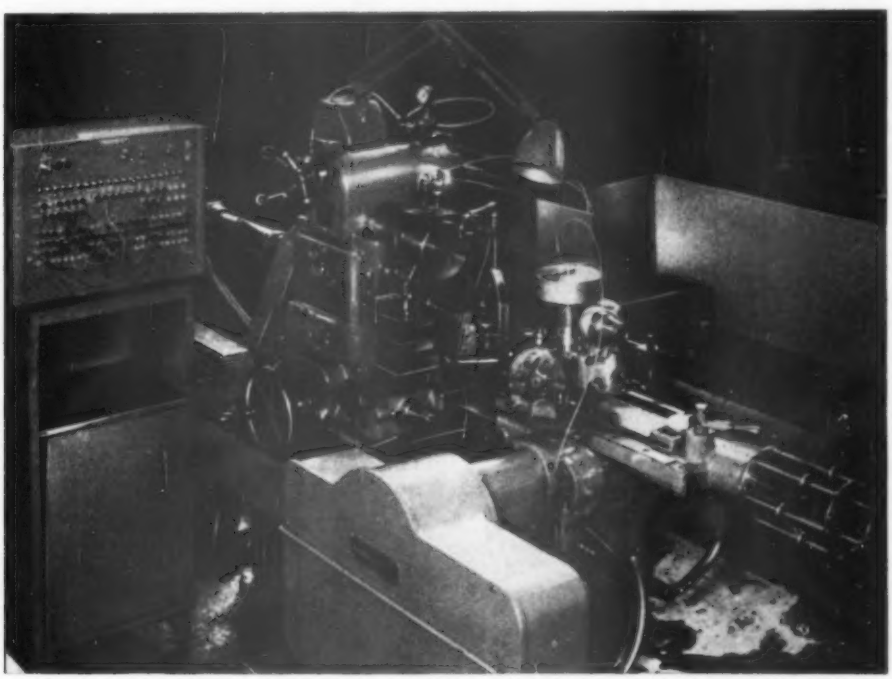
NOTWITHSTANDING the advances in machine tool design and construction and the improvement in cutting tools and machining techniques, the production of small or medium batches of components from bar stock or castings or forgings is still mainly carried out on manually operated capstan lathes. In total, this represents a considerable volume of work and the expenditure of a substantial amount of labour time. If batches are small, this work cannot be undertaken by more elaborate and more costly automatic machines due to the disproportion of the time required for tooling and setting against the time occupied in production. Furthermore, a more skilled grade of labour is required for tending such machines and, particularly, for setting.

As a result of their simplicity and generally robust construction, capstan lathes have a long, serviceable life. In numerous plants capstan lathes that, over years of useful operation, have been written down to zero are still serviceable. Under the influence of rising production requirements and greatly increased labour charges, however, they may tend to become uneconomic, since an operator is required for each machine. Mechanical aids or mechanization of certain operations can possibly effect some reduction in cycle time, but the operator will still remain with the machine throughout the cycle. Only complete automation will permit the operator to leave the machine during the cycle, even if, as in the case of chucked instead of bar work, he is required to unload and reload between cycles. Programmed sequence control is necessary to enable the machine to be employed in the production of a wide variety of components.

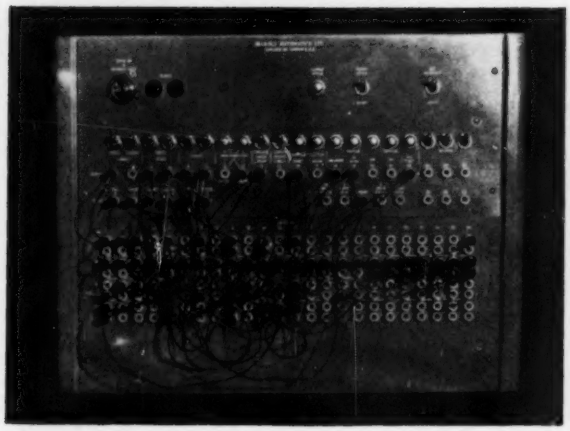
When making a study of this problem, Nickols Automatics Ltd., of Carlisle Road, London, N.W.9, decided that rather than design an entirely new and elaborate automatic machine to meet modern requirements, it was desirable to adapt and develop the long-established, virtually standard type of machine that is simple to operate, reliable in service and embodies so much practical experience. Whether converting existing machines or adapting new models for automatic operation, it was aimed to preserve the essential characteristics of the conventional machine and to match its robust construction, simple setting, reliability in service, and easy maintenance in the added equipment.

Personnel on the shop floor are familiar with tooling and setting problems encountered on the type of work upon which they are engaged and also with the accuracy and consistency of the spindles and slides of the machines. Programmed sequence control by means of a multi-bank stepping switch confers a number of advantages. The setting sequence can be drawn up in the planning office, recorded on a standardized setting chart, and issued to the shop. A capstan setter can tool and set up the machine in the normal manner and can quickly be taught to plug in the necessary cycle of machine movement on the programme panel. Cycle time can be planned in the office or worked out on the shop floor. In either case, times for individual operations can subsequently be adjusted, either reduced or extended, if found necessary. This is a facility not available on an ordinary automatic without re-camming the cycle.

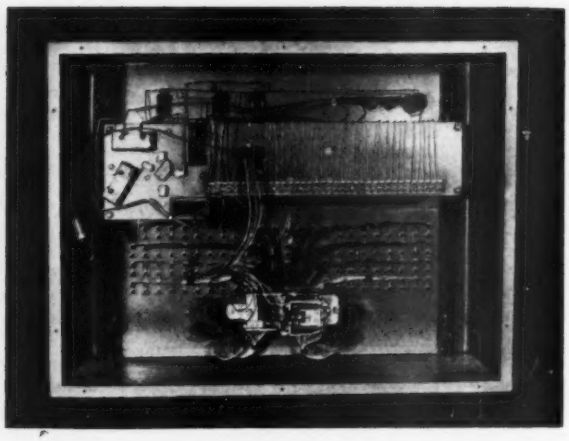
The original aims are well realized in the conversions



A Herbert 2D capstan lathe converted to fully automatic operation by Nickols Automatics Ltd.



Front view of the sequence control unit panel, showing method of programming by means of plug wires



Rear view of control panel with individual circuits wired up. The selector switch is the unit positioned at bottom centre

made by Nickols Automatics Ltd. in recent years and currently in service in numerous manufacturing plants. Incidentally, it is some of the largest concerns that have been most conscious of the economic advantage of conversion. Serviceable capstan lathes in their possession can be converted to automatic operation for an expenditure very much less than the first cost of a suitable automatic of similar capacity. Other firms are particularly interested in the simplicity of the setting procedure, which does not necessitate the engagement of highly skilled and highly rated labour.

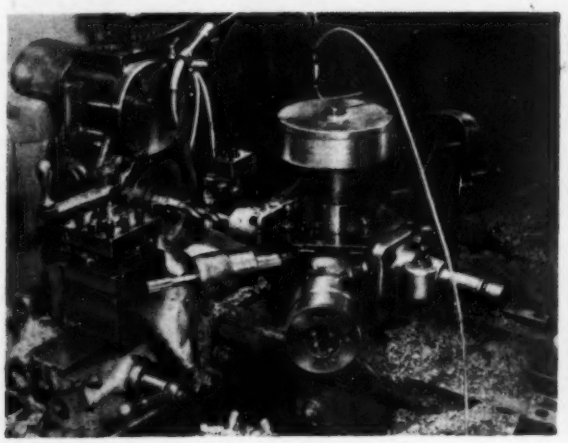
Ability to read a micrometer and to use the familiar screwed stops for dimensional control of machine movements is possessed by the majority of people in most machine shops, or can be readily taught. To use a punched card or punched tape system of control would call for precise planning, precise setting of tools to a datum, and a certain elaboration of equipment. This would elevate capstan work to a different plane. Furthermore, it would lack the flexibility of the familiar system of individually set operations. This is held to be of particular importance in small batch production and there is a reluctance to discard it.

Setting time on a converted machine may initially be expected to be from ten to fifteen minutes longer than is required for an ordinary capstan lathe. When experience is acquired, however, it is usually less, since manual control switches and air-hydraulic feeds enable the stops to be set more quickly. Then the time saved becomes more than sufficient to allow for plugging in the programme on the control board. As the thrust on each stop is unvarying in automatic operation, the setter need not expend time in returning to the machine for checking. This is a familiar routine on manually operated machines; made necessary as the operator gains experience and confidence in the production of a component and "slams" the machine.

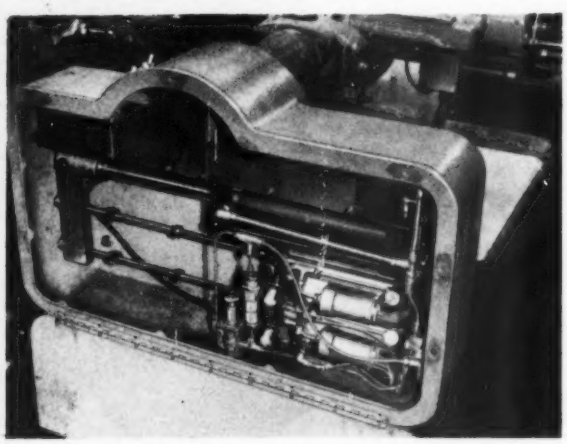
Reasoning on similar lines was applied to chucked work. Special chucks or fixtures could be fitted for a specific component and automatic loading hoppers or slides could be controlled from the programme board. The saving in labour would then be comparable with that for bar work. However, such methods would call for more equipment, much of which would be "special" for the particular component. Another disadvantage would arise since the work could not be put in hand until such special equipment was either made or received from an outside supplier.

On any component that does not demand the use of all the turret stations, the spare stations can be used for loading arms. In such circumstances the machine can function automatically for up to four complete cycles before again requiring the attention of the operator. This method enables a considerable saving of operator's time to be effected and he will be able to tend other machines during

Tooling does not differ materially from that used for manual operation



The turret actuation unit, shown with casing opened for inspection



the interval between loadings. With normal operation and the manual loading of the workpiece at each cycle, there will be but little saving of time unless the automatic part of the cycle operates for more than 30 sec.

When on bar work the machine is fully automatic and, apart from loading the bar stock, no operator is required. On relatively long runs the speed of operation is virtually the same as on a conventional single-spindle automatic. On medium or short runs, however, the machine shows to striking advantage in time required to effect the changeover from job to job. A highly skilled auto setter cannot change tools and re-set a single-spindle automatic nearly as quickly as an ordinary capstan setter can make the change on a Nickols-equipped automatic capstan lathe. For all bar work and most chucking work an operator can tend several machines.

An example of a familiar standard capstan lathe converted

Equipment for feeds actuation and control is mounted on the end of the machine. Covers are removed in this view

to fully automatic operation is illustrated. This is a Herbert 2D machine equipped for operation of the machine slides by air cylinder actuators, and feed motions by air cylinders working in conjunction with hydraulic restraining cylinders that are capable of wide adjustment for control. The mechanical feed of the machine is not discarded; being retained as its use may be of advantage in special cases when an exceptionally heavy cut has to be made. Drive is by the standard four-speed, pole-change motor and the two-speed clutch is air actuated. The turret is clamped by a direct-acting air cylinder.

No structural modification needs to be made to the machine. Consequently, the conversion can be effected expeditiously with a minimum down time. Commonly, all the necessary equipment is delivered in a light van and two fitters convert the machine on the shop floor and bring it into operation in two days. Conversion is a straightforward operation and no difficulty is likely to be encountered if the work is undertaken by the purchaser's tool fitters. In such cases and, of course, for export, the equipment is suitably labelled and boxed and forwarded with full, sequential instructions for assembly.

SETTING CHART

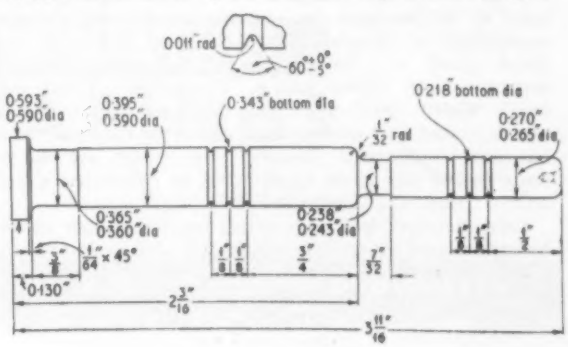
Part name: *Plunger ¾ in diameter* *Part No. A.101*

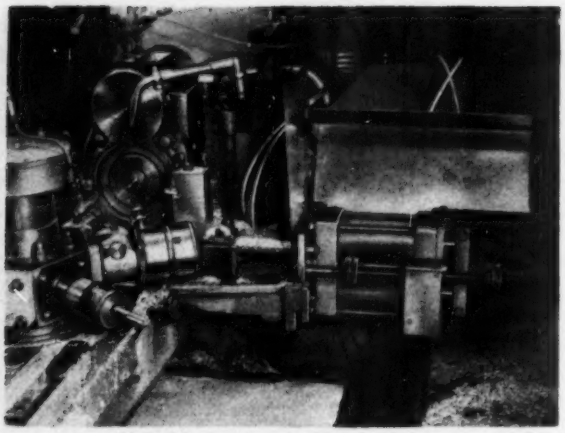
Material: *Ledloy* *Cycle time 2 min 30 sec*

BANK				Step	r.p.m.	Feed	Motions	Signal
4	3	2	1					
16	2		1	1			Advance turret to stop. Engage fast clutch	T/F
	9	8	1	2			Hold turret forward. Open collet	C/O
22	11	10	1	3	810		Hold turret forward. Close collet. Start motor 4th speed	C/C
	3	13		4		320	Index turret. Set feed rate	T/B
	2	14	1	5		320	Advance turret. Turn 0·265 in dia. Mechanical feed	T/F
	3			6			Index turret	T/B
	2	14	1	7		320	Advance turret. Turn 0·395 in dia. Mechanical feed	T/F
	3			8			Index turret	T/B
	2		1	9		H/CK	Advance turret. Form end radius. (Roller steady tool). Hydraulic check feed	T/F
	3			10			Index turret	T/B
	2		1	11		H/CK	Advance turret. Centre drill 60 deg. Hydraulic check feed	T/F
21	3			12	540		Index turret. Change motor speed (3rd)	T/B
	2		1	13			Advance turret with roller steady and revolving centre	T/F
4	5		1	14			Hold turret. Advance front slide. Form grooves and undercuts	F.T/P
4	M		1	15			Hold turret. Front slide tool dwells against stop	T/D
4	L	19	1	16	270		Hold turret. Front slide tool dwells against stop. Reduce motor speed (1st)	T/D
6	3	22		17	810		Change motor speed (4th). Advance rear slide to cut off	T/B
6	7			18			Signal rear slide end of stroke	R.T/P
	H		18	19			Home. Stop motor	H
	H			20			Home	H
	H			21			Home	H
	H			22			Home	H
	H			23			Home	H
	H			24			Home	H

C/C collet close; C/O collet open; F.T/P front tool post; H home; H/CK hydraulic check; L long dwell; M medium dwell; R.T/P rear tool post; T/B turret back; T/D turret dwell; T/F turret forward.

Typical component in Ledloy free-cutting steel, produced on a Nickols-equipped Herbert 2D capstan lathe at a cycle time of 2½ min





Cross-slide actuation unit, with cover lifted

A standard control cabinet—both front and rear views of the divided front panel are shown—is arranged for 24 operational steps, but panels for more or fewer such steps can be provided according to the type of component to be produced on the machine. The upper panel houses the signal light, fuses, main switches, hand switches, and sockets connected to valves and relays controlling equipment on the machine. In the lower panel are 96 twin sockets arranged in four banks each of 24 steps. Each step consists of four sockets arranged in vertical alignment.

The lower panel can supply power, at 110 volt, A.C., by way of plug wires to the sockets in the upper panel. For each step the maximum capacity is three motions and one signal. A "motion" is any automated function on the machine and a "signal" is a micro-switch actuating a stepping switch, termed the "selector switch". Power can be transmitted in this way on 24 steps, proceeding from left to right. Only one step can be energized at a time, making it a "live" step.

Switchover of the power supply from one step to the next is through the selector switch, which is actuated by the signal on the live step. A micro-switch, normally open, is positioned at each end of the three main motions; turret slide, cross slide, and collet actuator. When the micro-switch that has been selected on the live step is closed by movement of the respective slide, a circuit is completed to send a signal back to the selector switch, which moves one step. Thus power is cut off from one step of four sockets and the next step is made "live".

Manual control is used for single-operation switching when setting or if required for a special "one-off" job. Each switch or push-button actuates a specific function, such as "Turret feed" by a solenoid valve, air cylinder, and a rack and pinion mechanism, or "Third speed" by contactor switches for the pole-change motor. On an automatic cycle some of the functions, for example motor speed changes, engagement of mechanical feed gears, or locking of the turret clamp may be assumed to take place virtually instantaneously. Others such as "Turret feed", "Cross-slide feed", "Collet open" or "Collet shut" are furnished with signals to feed back information that the relevant movement has been completed. Usually these signals are micro-switches but they could equally well be photo-electric cell units or automatic sizing gauges.

Each function and each signal has a separate circuit brought up to its specific switch and plug socket on the upper control panel. Each circuit can thus be immediately localized and individually tested in the event of any malfunction. Adjustment or rectification can be made without disturbing the rest of the set-up. Three rates of feed are provided, respectively 80, 160, and 320 cuts per inch. On certain operations, centring, bottoming holes, and tap withdrawal for example, a time delay is required to allow the tool to dwell. Three dwell periods, designated short, medium, and long, and having a duration of 1½ sec, 3 sec, and 5 sec, can be programmed into the cycle.

The line drawing shows a typical component produced on a Nickols-equipped Herbert 2D capstan lathe. The material is $\frac{15}{16}$ in diameter Ledloy free-cutting steel, of casehardening quality, and the cycle time on fully automatic operation is 2 min 30 sec. Limits are given for certain dimensions but all others are subject to standard tolerances of ±0·008 in for fractions up to ¼ in, ±0·015 in for fractions above ¼ in, and ±0·005 in for decimals. The replica of the setting chart for this component, programmed in the planning office and issued to the shop, contains full information of each sequential operation to enable the setter to set up the machine and connect up the control unit

In the production of mild steel or brass components from bar stock, substantial economies in both time and part cost can be effected by conversion to automatic operation. Individual cases will vary according to such factors as material, complexity, number of machining motions and, of course, the size of the batch and consequent length of run. In general terms, savings in time of from 25 per cent to 50 per cent can be made in the time taken on normal manual operation of the lathe. Some representative examples of components in brass may be quoted. In one, made from $1\frac{7}{16}$ in diameter bar in batches of 1,000, the production time of 3 min was reduced to 90 sec on a converted machine. In another instance components were made in batches of 1,000 from $1\frac{1}{8}$ in diameter stock in $2\frac{1}{4}$ min per part. This time was cut to 85 sec by automation.

As regards production costs, the record of machines in ordinary commercial service is equally good. One large firm operating several converted capstan lathes conducted a survey in their own plant and took meticulously careful costings of a number of typical steel components for comparison with their previously established costings for the same items produced on the same lathes before conversion. The following examples of small- and medium-batched items is representative of the reductions obtained. Spherical washer, batch 2,000, reduced from 2·21d to 1·32d per part; dowel, batch 2,000, from 2·15d to 1·035d; special bolt, batch 500, 3·8d to 2·13d; and roller, batch 500, from 2·51d to 1·17d.

There are, of course, coincidental advantages to be gained from automatic operation which, while tangible in their effect on production are relatively difficult to assess in terms of time or cost values. As a result of constantly controlled speeds, feeds, and pressures against dead stops, improved accuracy and finish of the work is obtained and the number of rejects is reduced. For the same reason there is an extension in the working life of the tools and less down time expended on regrinds and resetting. Breaking of drills and taps arising from carelessness, forgetfulness, or physical tiredness of the operator are eliminated and the quality of threading generally is sensibly improved.

Computers

AN informal discussion, on the subject "The Computer In Production", is being organized on 21st and 22nd March 1960, by The Institution of Mechanical Engineers. The purpose of the meeting is to introduce mechanical engineers and executives to the latest techniques and to provide a forum for these people to present their views to the manufacturers of computers. Several distinguished engineers and users of computers will give talks; the discussion will not be reported. Applications to attend should be made to the Secretary of the Institution.

'Brobdingnagian or Lilliputian?

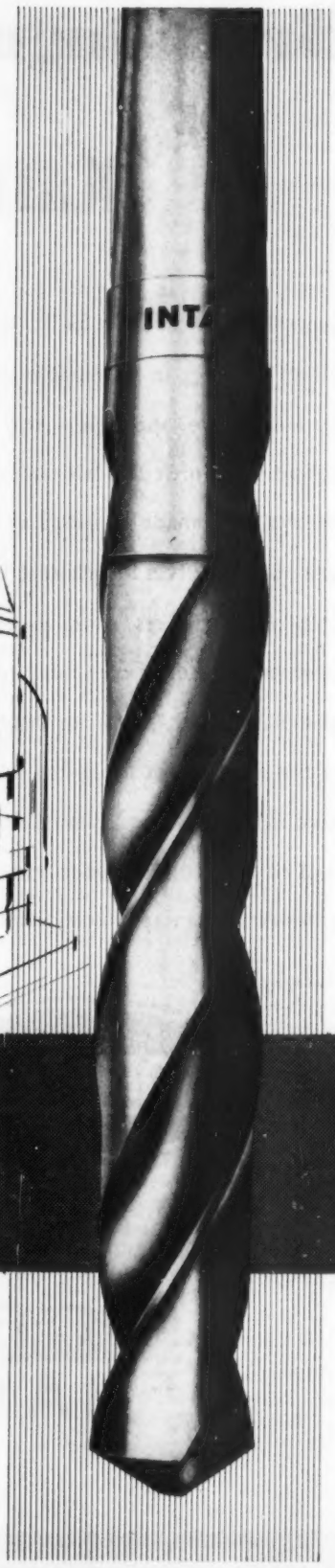
It is improbable that Dean Swift had any thoughts about ball bearings in his curious romancings, but he would, we believe, appreciate the well-balanced design and fine finish of both our big and little fellows. We have made bearings as large as 5' 0" diameter to support a locomotive turntable whilst their tiny counterparts, some as small as 3mm, diameter, may be used on a very high speed dental drill, or perhaps for an instrument where the need is not for speed but extremely sensitive motion. These Lilliputians of engineering are held to B.S.I. limits of accuracy or to the American specifications ABEC 3, 5 or 7.

HOFFMANN

PRECISION MINIATURE
BALL BEARINGS

THE HOFFMANN MANUFACTURING CO. LTD., CHELMSFORD, ESSEX

small drills
or
LARGE DRILLS
—— insist on



INTAL

The twist drill par excellence

London Office and Stock
6/9 Red Lion Market, Whitecross Street, London, E.C.1. *Tel:* MONarch 8771-2

Birmingham Office and Stock
81 Headingley Road, Handsworth, Birmingham. *Tel:* NORthern 8211

Manchester Office and Stock
177 Dickenson Road, Manchester, 13. *Tel:* RUSholme 7313-4

Scottish Agent and Stockist
John Warden, 50 Wellington Street, Glasgow, C.2.
Tel: City 6994 (2 lines) *Grams:* Precise, Glasgow

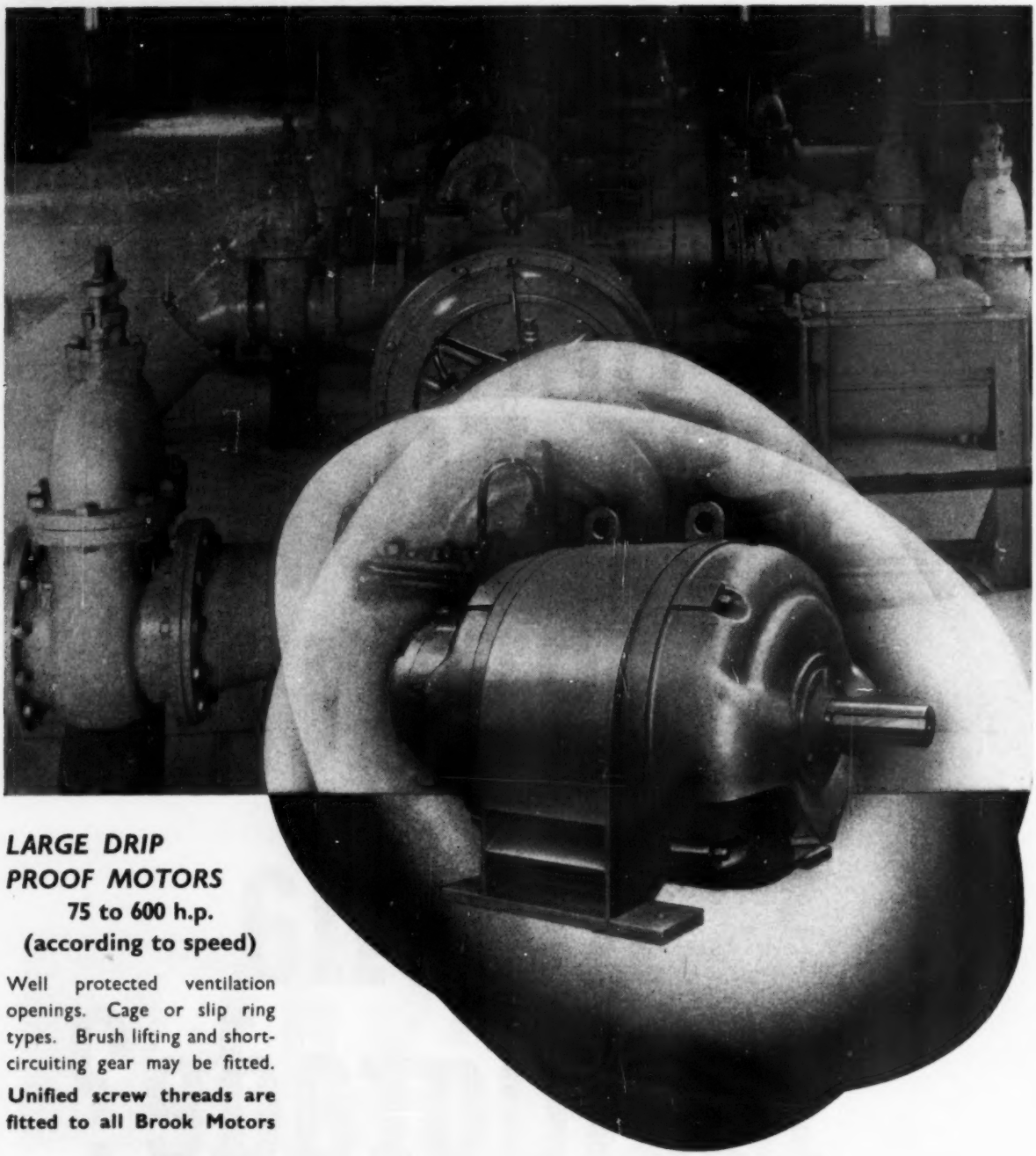
THE INTERNATIONAL TWIST DRILL CO. LTD. INTAL WORKS, WATERY STREET, SHEFFIELD 3
Telephone : 23072 (3 lines) ***Grams : "Fluted, Sheffield"***

CAN YOU AFFORD NOT TO TRY Shell Rotella Multigrade?

SHELL

Shell Rotella Multigrade Oils

LEADERSHIP IN LUBRICATION



LARGE DRIP PROOF MOTORS

75 to 600 h.p. (according to speed)

Well protected ventilation openings. Cage or slip ring types. Brush lifting and short-circuiting gear may be fitted.

Unified screw threads are fitted to all Brook Motors

BROOK MOTORS Ltd

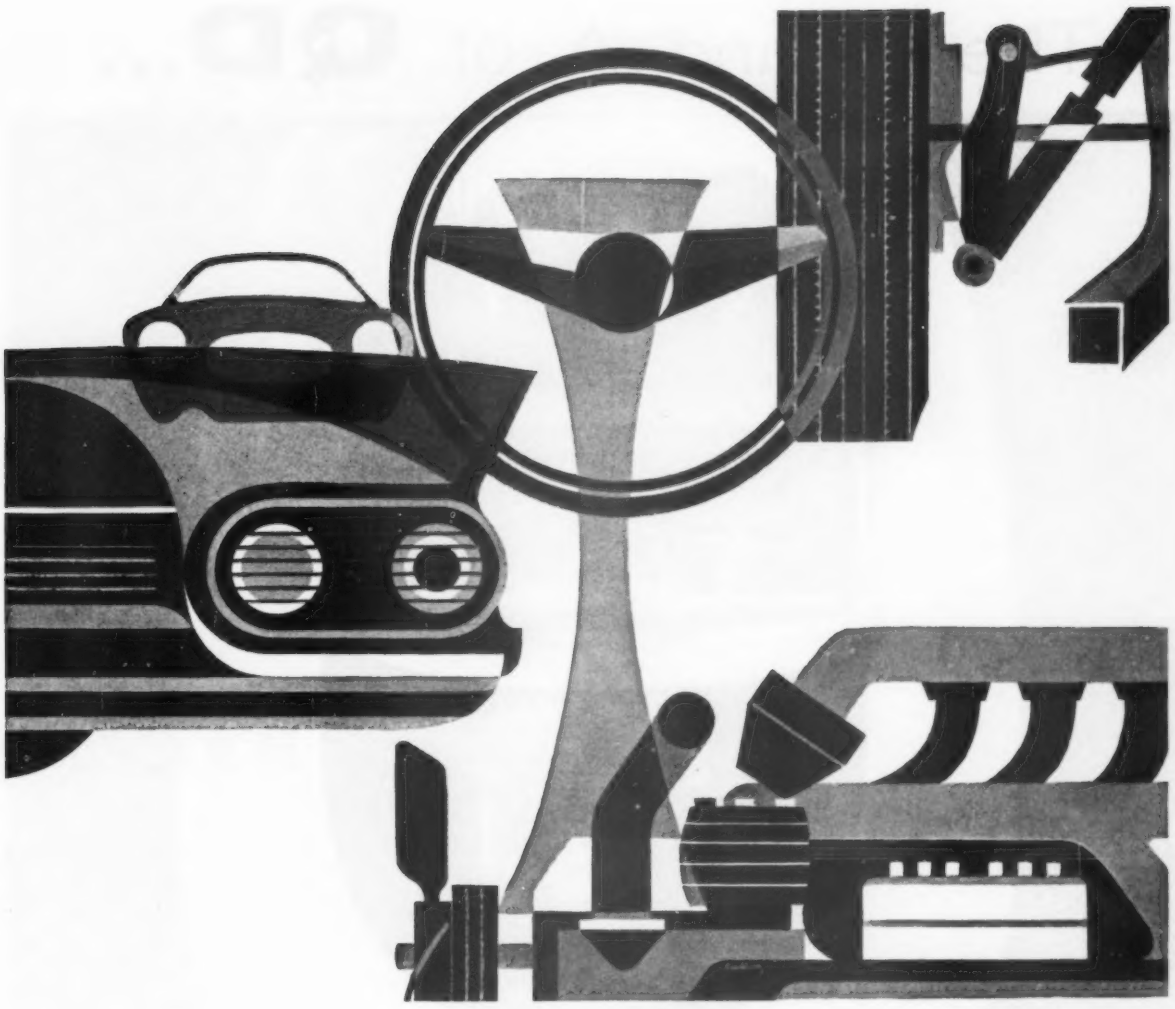
HUDDERSFIELD

LARGE MOTORS FOR HEAVY WORK

Whether your application calls for a drip proof or totally enclosed motor in the larger horse power range, Brook can supply just what you need. Consult their Technical Service Department about your large motor requirements.

Helpful advice and prices available on request.

59/3



The future of design

E.M.I. Electronics Ltd. is now working in collaboration with leading motor manufacturers on an important new aid to design engineers -- the application of analogue computer techniques to motor vehicle design.

Problems concerning dynamic behaviour, such as road holding, ride and stability of all types of vehicle, are all within the scope of EMIAC II — the most versatile analogue computer available today. EMIAC II enables studies of different vehicle design features (e.g. suspension, steering, mass distribution, etc.) to be undertaken rapidly and informatively, thus readily optimising the overall design. Studies are in progress embracing all aspects of vehicle design.

Originally evolved to solve the immensely complicated problems of guided weapon design, analogue computers have proved their worth in many other fields, and EMIAC II is daily solving problems for a number of leading aircraft and guided weapon companies, chemical plant engineers, and designers in numerous industries and research establishments.

Our book "Take Liberties with Time" fully describes **EMIAC II** *and its capabilities. Ask us for a copy now. Specific information is also available from our Analogue Computer Study Group.*

EMI

E.M.I. ELECTRONICS LTD

CONTINUOUS PROCESS CONTROL DIVISION · HAYES · MIDDLESEX · TEL: SOUTHALL 2468

EE39

The Q and A of **QD...**

Q **Nice aroma! What's that tobacco ?**

D Oh, just my usual.

Q **It's certainly a better smelling smoke than is coming from that truck over there.**

D He should do what I've done.

Q **What's that ?**

D Fit Q.D. Pistons.

Q **How come ?**

D They put the guts back into flagging engines. Stop all that oil burning.

Q **Costly ?**

D No fear, they pay for themselves in no time on oil and fuel saving. Half my fleet's running on 'em.

Q **And the other half ?**

D In future when a van starts burning oil at say 25,000, it's going in for Q.D., I should then get another 25,000 without further worry.

Q **Mmm I must look into this idea.**

WELLWORTHY
THE CHOICE OF THE EXPERT

Ask your local dealer now about fitting Duaflex rings or Q.D. pistons.
Or send now for a free booklet to Dept. A12A

WELLWORTHY LTD · LYMINGTON · HANTS

HIDDEN TREASURES

Deep in the waters of the Persian Gulf . . . along the coasts of Ceylon, Australia, Borneo, Venezuela . . . in the lagoons of the Pacific Islands . . . are found the pearl oysters, valued for the beautiful product which has been used for personal adornment since primitive man first used shell fish for food.

And deep in the heart of the world's finest car engines lies another treasure . . . a RENOLD TIMING CHAIN. *It's a gem of a chain—smooth running and flexible, capable of innumerable driving arrangements and outliving the engine itself.*

RENOLD **TIMING CHAINS** *stand the test of time*

RENOLD

RENOLD CHAINS LIMITED • MANCHESTER

FRY'S Solders speed production

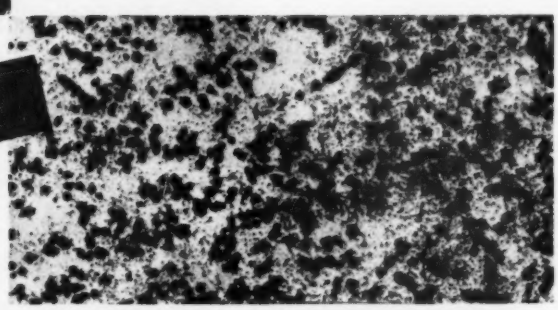
PURITY

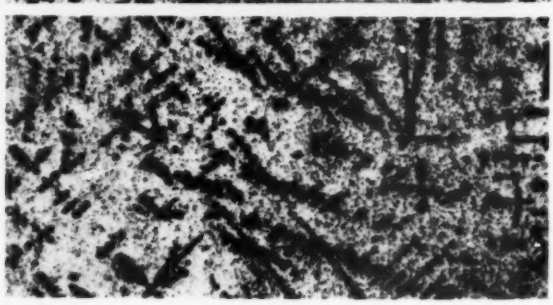
That means FRY'S Solders work *fast*, save costly man hours, keeping pace with your production line.

CONSISTENCY

FRY'S Solders constantly undergo rigid laboratory tests ensuring perfect soldering at all times.

THE CAMERA PROVES





★ These "spotty" patterns are, in fact, photo-micrographs. They are produced as a routine check on every batch produced from FRY'S works.

The top print shows the regular pattern which produces firm smooth globules that roll-on and bond firmly at all times.

★ That below indicates the effect of impurities. This solder would be gritty and porous—in fact, would be immediately rejected.

FRY'S Metal Foundries Limited

Tandem Works, Merton Abbey, S.W.19.
Tel: MITCHAM 4023 (7 lines).

And at MANCHESTER · GLASGOW · KIDDERMINSTER · DUBLIN

MRP.102

When one stops to think about it there are not many forms of transport that do not include Hardy Spicer Propeller Shafts and Universal Joints. In fact they tend to be taken very much for granted when people get round to talking about dependability, design, and performance. Take a look at the range of commercial vehicles depending on Hardy Spicer Propeller Shafts and Universal Joints and you will see what we mean.

HARDY SPICER

PROPELLER SHAFTS

HARDY SPICER LIMITED

CHESTER ROAD · ERDINGTON · BIRMINGHAM 24 · ERDINGTON 2191 (18 LINES)

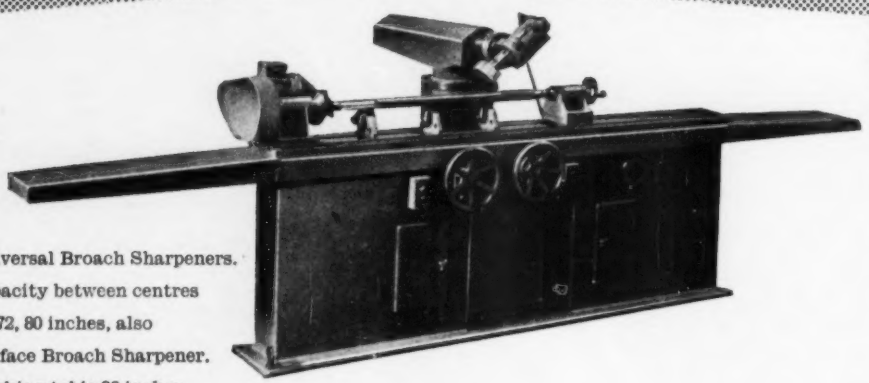
Automotive Division of BIRFIELD INDUSTRIES LIMITED.

product of the

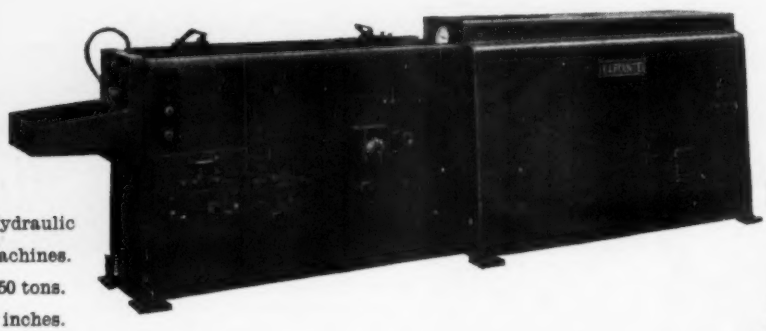
Birfield Group

come to

LAPOINTE **for better broaching**



Universal Broach Sharpeners.
Capacity between centres
60, 72, 80 inches, also
Surface Broach Sharpener.
Working table 36 inches.



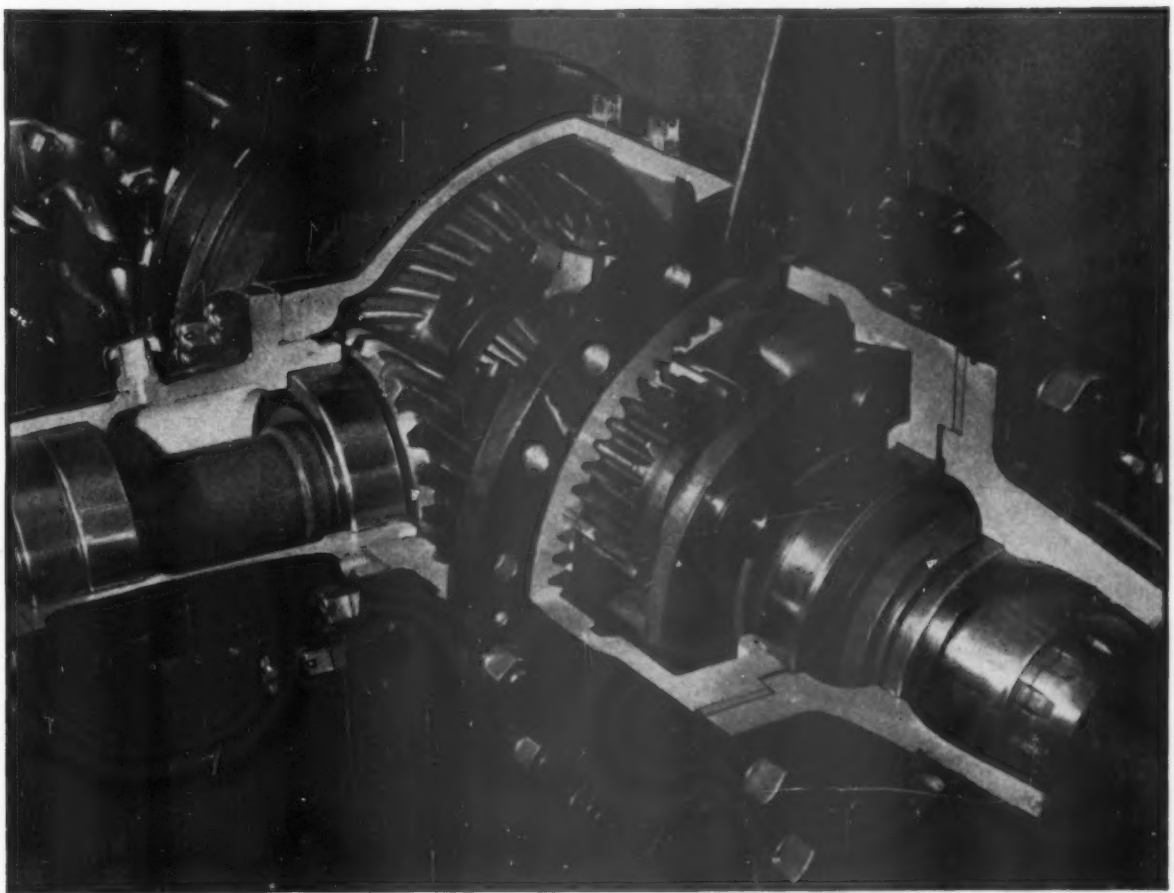
Horizontal Hydraulic
Broaching Machines.
Capacity: 2½-50 tons.
Stroke: 30-78 inches.

British Made

The Lapointe Machine Tool Co Ltd

Otterspool Watford-by-Pass Watford Herts
Telephone Watford 31711/2/3/4 Cables Lapointe Watford
Also The Lapointe Machine Tool Company Hudson Mass. USA

High Quality DROP FORGINGS



Differential gear assembly in Heavy Duty Driving Axle *Photograph by permission of Scammell Lorries Limited*

for the automobile and transport industries

by

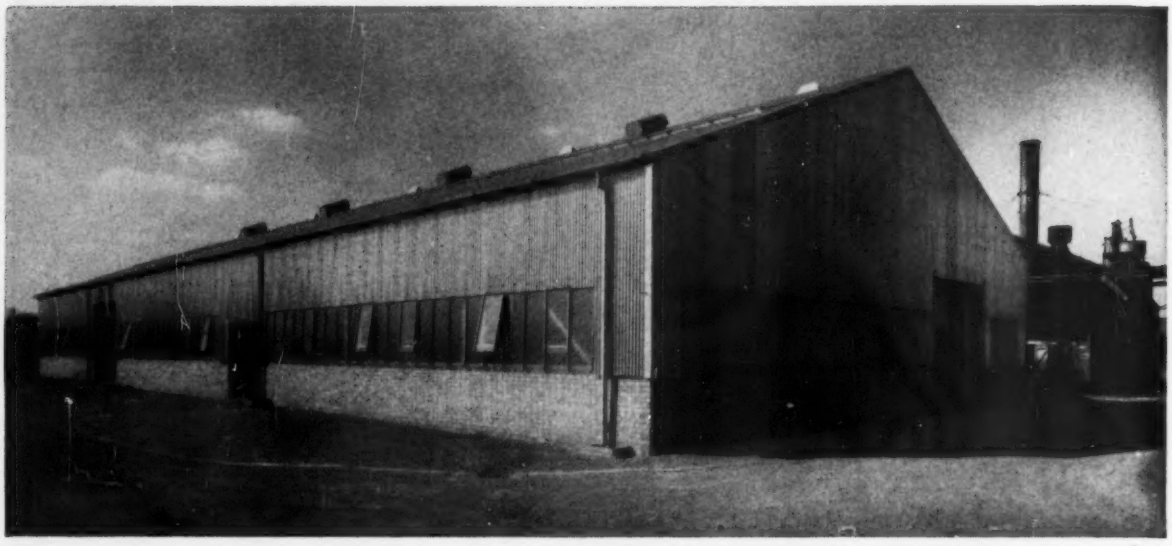
FIRTH - DERIHON

SHEFFIELD & DARLEY DALE

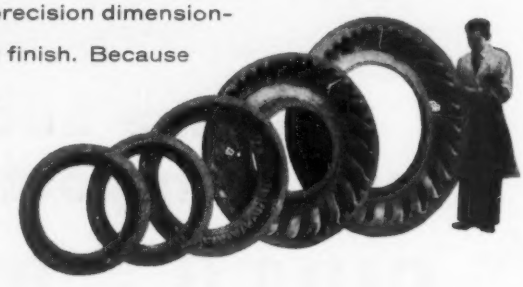
A 16mm. Colour Film with sound commentary, entitled "Drop Forgings in Alloy Steels," is available on request

THE FIRTH-DERIHON STAMPINGS LIMITED, SHEFFIELD.

Extending our Facilities



To deal with constantly increasing demands, this new extension to the William Mills Works at Wednesbury has been built specifically for the production of light alloy castings by plaster moulding. Castings produced by this method are of high precision dimensionally and have an excellent surface finish. Because of the quality and accuracy of the castings, tyre moulds of the types illustrated are produced by the plaster moulding system.

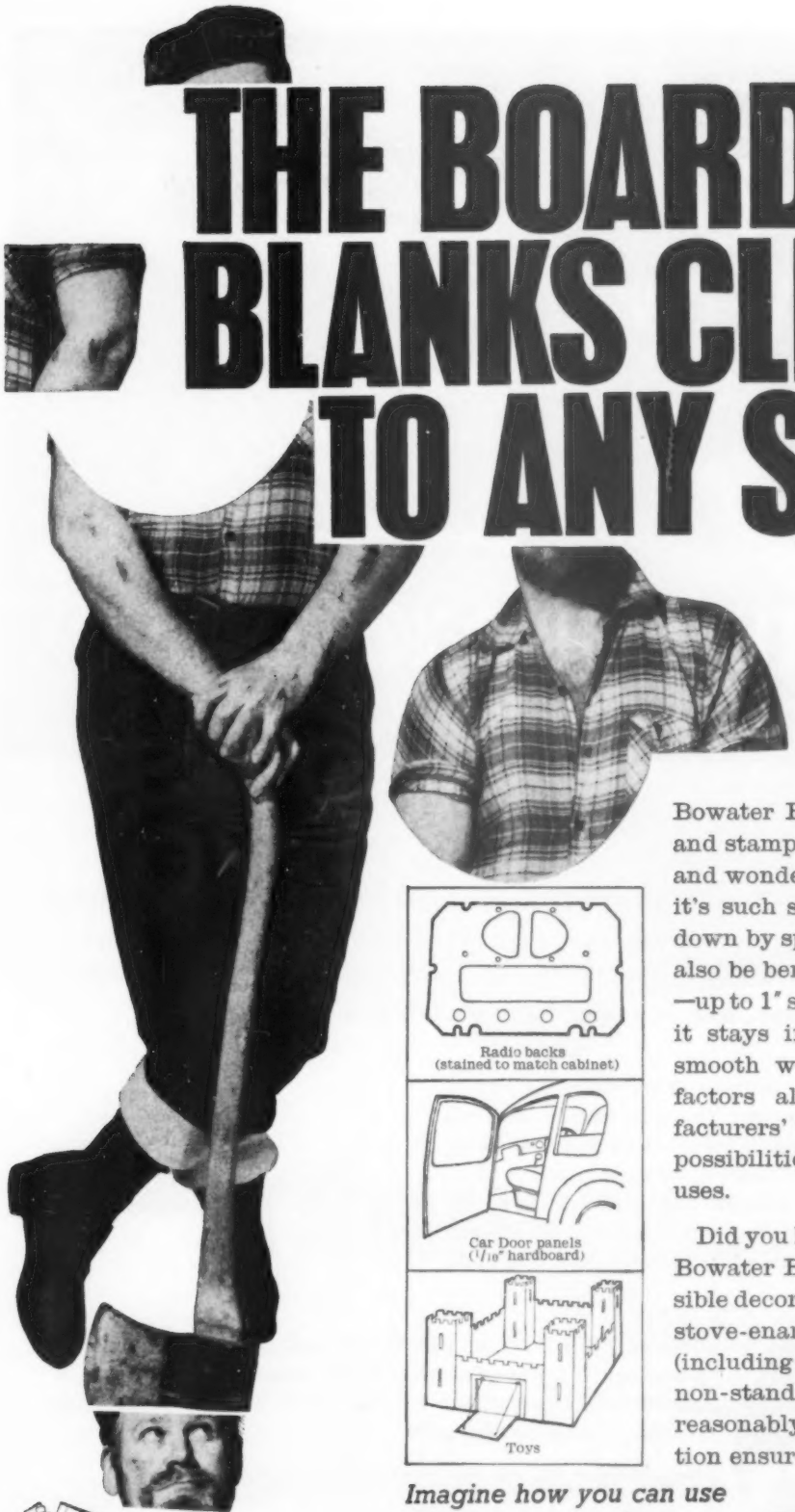


William Mills Limited

FOUNDERS IN ALUMINIUM ALLOYS

FRIAR PARK FOUNDRY, FRIAR PARK ROAD, WEDNESBURY, STAFFS. TELEPHONE: STONECROSS 2276/7
AP 130

THE BOARD THAT BLANKS CLEANLY TO ANY SHAPE



Radio backs
(stained to match cabinet)

Car Door panels
($^{1}/_{10}$" hardboard)

Toys

Bowater Board is regularly punched and stamped out to hundreds of weird and wonderful shapes in industry and it's such strong stuff it never lets us down by splitting or splintering. It can also be bent to some pretty acute radii —up to 1" sometimes!—and there again it stays intact and never loses its smooth working surface. These two factors alone have opened manufacturers' eyes to its almost limitless possibilities—we show three current uses.

Did you know these other facts about Bowater Board? ★Wide range of possible decorative finishes from P.V.C. to stove-enamel. ★Many standard sizes (including economical 5 ft. widths) and non-standard measurements cut for reasonably long runs. ★Home production ensures reliable delivery.

Like a booklet and some samples to start you thinking? Write to:

Imagine how you can use

Bowater Board

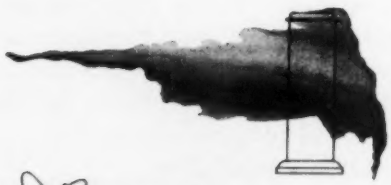
BUILDING BOARDS DIVISION, BOWATERS SALES COMPANY LIMITED,
BOWATER HOUSE, KNIGHTSBRIDGE, LONDON SW1. TEL: KNI 7070

CBC 61b1

FOR
Diecastings as strong as steel
ALUMINIUM BRONZE CO., LTD.
Wallows Lane · Walsall · Staffs.
Telephone: WALSALL 2108 (3 lines)
Telegrams: "ABCO · WALSALL"

The liquefaction of gases is an important branch of low temperature physics. Its importance is stressed by the fact that, of recent years, increasing use has been made in both industry and science of liquefied gases, such as oxygen, nitrogen, helium and hydrogen.

In the automobile industry new methods of increasing the flow of production are constantly being sought. One such method, involving the use of liquid oxygen, or nitrogen, is defined by the term "Shrinkage Fits". This denotes a process of freeze-shrinking the shaft or insert by immersion in either of these liquefied gases, down to minus 185/196°C. The simplicity of such a process, combined with its saving of many hours, gives it a considerable advantage over more traditional methods.



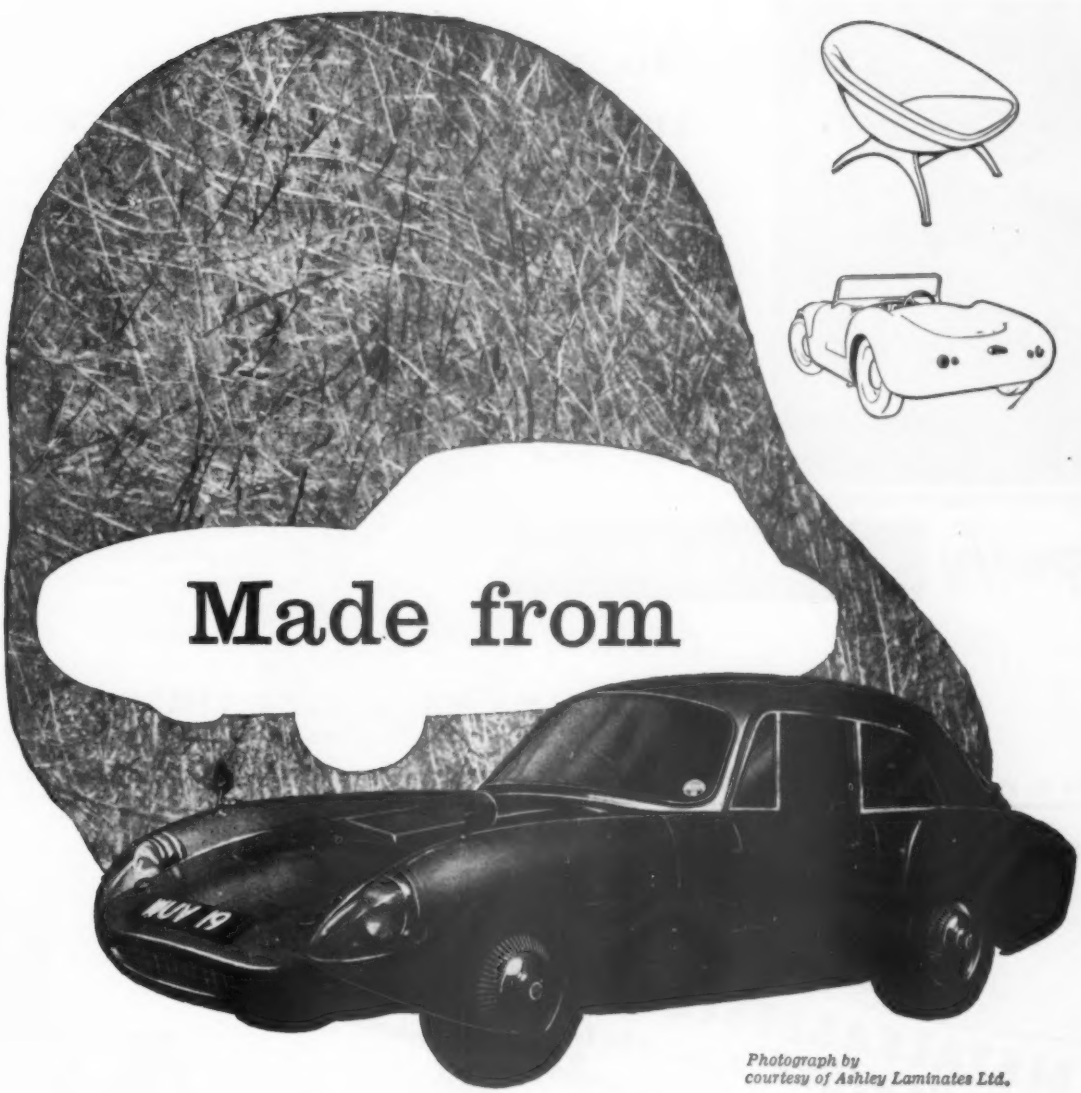
Here, at Dupree Swift, we make the spherical copper vacuum container (above right) for storage of liquid oxygen or nitrogen, and the cylindrical, or soaker type (left) for immersion of the insert, as stated above, in either of these liquefied gases.

Our catalogue will tell you more about our products— just write or telephone.

DUPREE SWIFT
& COMPANY LIMITED

23/25, Broadwall, Blackfriars, London, S.E.1.

Established 1919 *Tel: WATerloo 5750*



Photograph by courtesy of Ashley Laminates Ltd.

TURNERS

DURAGLAS Regd.

GLASS FIBRE REINFORCEMENTS

For information on all products in the Duraglas range, including glass yarn, roving, cloth, woven roving, tape and Duramat write for publication D3.

"TURNERS" is the trade name of

TURNER BROTHERS ASBESTOS CO. LTD · ROCHDALE · ENGLAND

A MEMBER OF THE **TURNER & NEWALL** ORGANISATION

TA 168

Machining on single spindle automatic

Do you still have trouble with tolerances?

You've checked the tool angles, the setting-up, the rate of feed and spindle speeds, but have you checked the cutting fluid? This can have a great bearing on the accuracy of any machining operation. Put a FLETCHER MILLER cutting fluid in the sump and you will notice the difference. Both tools and workpiece are thoroughly cooled, close tolerances are maintained, chip welding is eliminated—and life of the tool bit is extended. Interested? Write for a copy of Publication SP.173 "Cutting Fluids" which describes the whole range of FLETCHER MILLER cutting fluids.

S W I F T

This range of straight cutting oils includes various grades of sulphurised oils, sulpho-chlorinated oils and non-sulphurised oils. They all have one common characteristic - they service the most severe tooling set-ups with complete efficiency.

specify FLETCHER MILLER *cutting fluids*

FLETCHER MILLER LTD., ALMA MILLS, HYDE, CHESHIRE.

Telephone: HYDE 3471 (5 LINES) *Telegrams:* EMULSION, HYDE

Also at LONDON, WEST BROMWICH, NEWCASTLE-ON-TYNE, CARDIFF, GLASGOW AND BELFAST

CF 124

METAL & ASBESTOS GASKETS *for* **VEHICLE** *manufacturers*

Manufacturers' Enquiries only

MANUFACTURERS OF JOINTS & GASKETS FOR ALL TYPES OF I.C. ENGINES & POWER UNITS

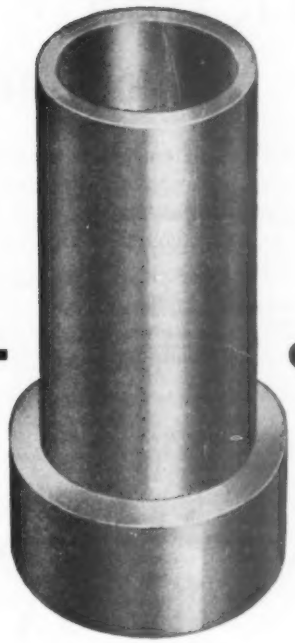
Specialists in the quantity production of small metal pressings.

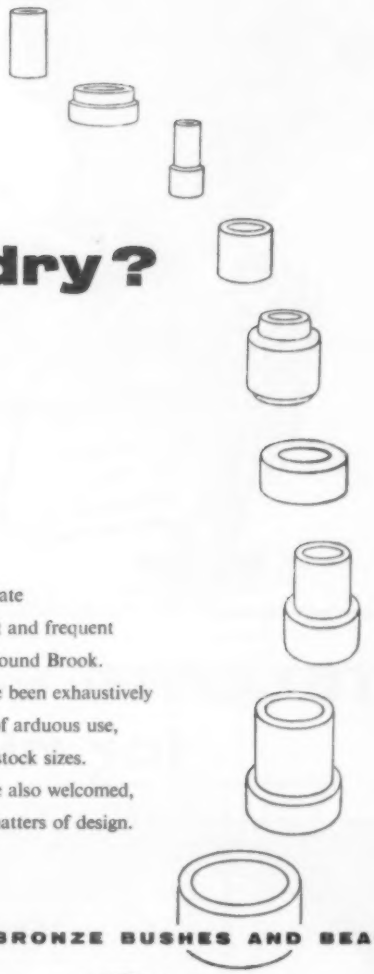
THE COPPER & ASBESTOS WASHER CO. LTD.

LEIGHSWOOD INDUSTRIAL ESTATE, NORTHGATE, ALDRIDGE, STAFFS.

Telephone: ALDRIDGE 52951.

SWEET- or dry?



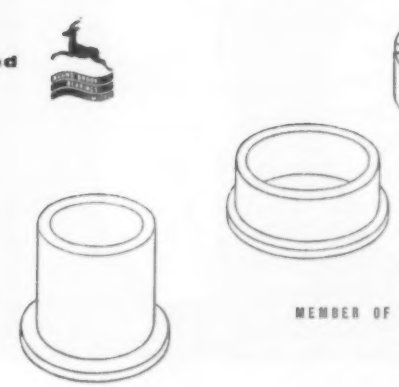


The choice of bearings—whether they will operate sweetly, or run dry, in locations where constant and frequent attention is impossible—has a ready answer: Bound Brook. These oil-retaining sintered metal bearings have been exhaustively and thoroughly proved reliable through years of arduous use, and are available in a comprehensive range of stock sizes. Enquiries for special Bound Brook bearings are also welcomed, and we offer consultative technical advice on matters of design.

BOUND BROOK OIL-RETAINING BRONZE BUSHES AND BEARINGS

Bound Brook Bearings Limited

Trent Valley Road, Lichfield, Staffs.
Telephone: Lichfield 2027/8.



MEMBER OF THE BIRFIELD GROUP

JOHN BULL RUBBER CO. LTD. (INDUSTRIAL SALES DIVISION) LEICESTER TELEPHONE 36331

Is it time you called in *'Doc'?*

Are you suffering from headaches caused by not knowing what you want, not getting what you want, not liking what you get nor getting it when you want it? If so, it's high time you called in 'Doc'.

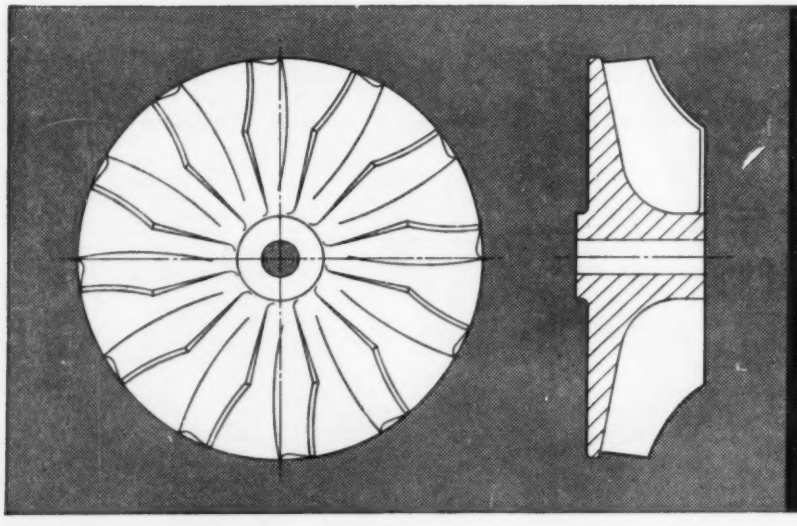
'Doc' is the personification of all the scientific and technological 'know-how' in the John Bull organisation. Rubber: he knows rubber. Rubber in any shape or form, for any purpose under any conditions.

Call him in. Hand your problems to him. Feel a new man.

JOHN BULL *Rubber*

Solves your problems

"STELLITE" cobalt base castings for high temperature use



Ease of casting produces intricate shapes to highest standards of soundness, accuracy and surface finish

Excellent high temperature properties

Unlimited supplies of alloy available

Competitive price

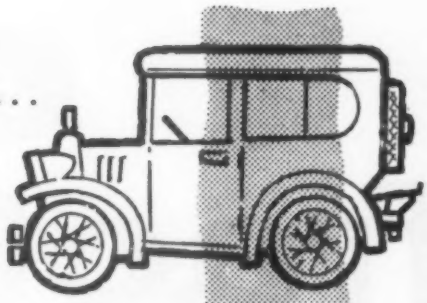
High scrap value of metal

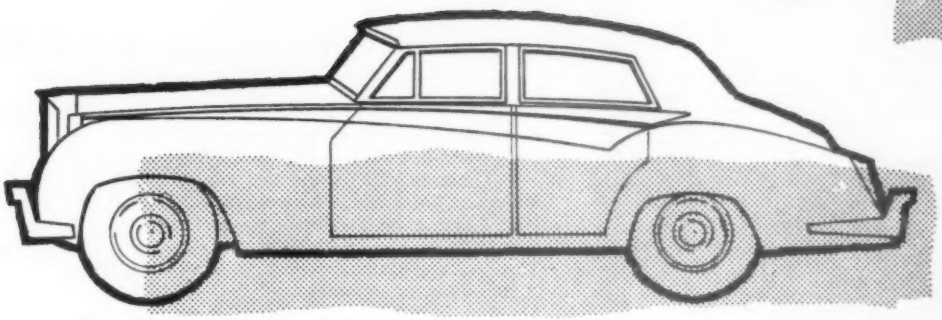
DELORO STELLITE

DELORO STELLITE LIMITED · HIGHLANDS ROAD · SHIRLEY · SOLIHULL · WARWICKSHIRE
DELORO STELLITE DIV. OF DELORO SMELTING & REFINING CO. LTD. BELLEVILLE · ONTARIO · CANADA

A.D. NO. 290

THERE ARE CARS . . .





AND CARS

AND THERE IS

CHROMIUM PLATE

AND CHROMIUM PLATE

Efco-Udylite

BRIGHT NICKEL PROCESSES

PROVIDE THE PERFECT UNDERCOAT FOR CHROMIUM

There is no finish for the bright parts of a motor car to equal good chromium plate for brilliance, appearance, ease of maintenance and low initial cost.
The world's best cars are fitted with many parts plated on **EFCO-UDYLITE** automatic plating machines by **EFCO-UDYLITE** plating processes.
Pre-eminent in their field, **EFCO-UDYLITE** design and research continually advance the standards of plating quality.

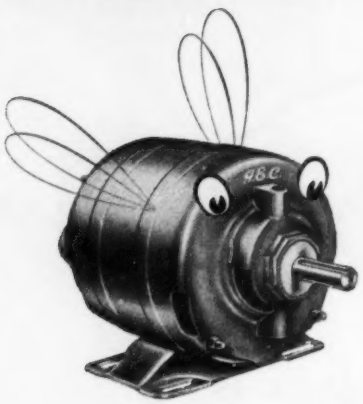
EFCO **ELECTRO-CHEMICAL ENGINEERING CO. LTD.**
SHEERWATER, WOKING, SURREY. *Telephone* WOKING 5222-7

MRP 2813

G.E.C.

fractionals

put power where you want it



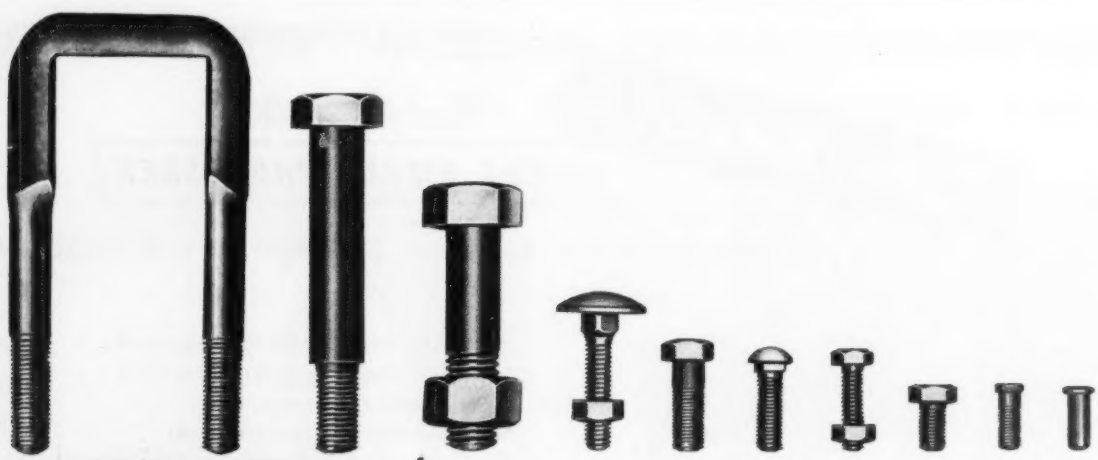
The Busy Bee from G.E.C.

Power for many purposes. Power to drive your own plant efficiently, or to add further distinction to the equipment you make and sell. Power. As much (up to 1 h.p.) or as little as you need, in a wide range of mountings, but always with the reliability for which all G.E.C. engineering is famous. Power, from sturdy, dependable G.E.C. Fractionals.
Most sizes and mountings are held in stock—that's another advantage of dealing with the G.E.C.

G.E.C. manufacture many types and sizes of fractional motors for light industrial and domestic drives—whether for your plant or products our engineers will always be pleased to help you choose the right motor for the job.

Fully detailed illustrated publication on application.

THE GENERAL ELECTRIC CO. LTD.,
MAGNET HOUSE, KINGSWAY, LONDON, W.C.2



WILEY

Whatever your fastening problem, Wiley can make a bolt for it—and a nut too—ask them!

make a bolt for it!

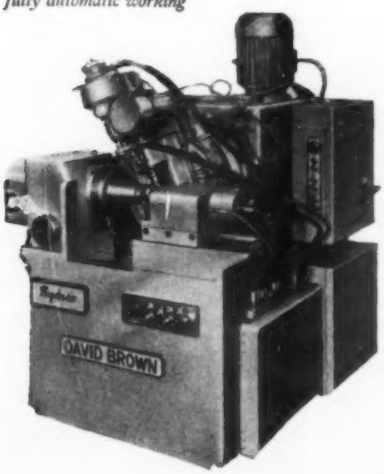
JAMES WILEY & SONS LIMITED, DARLASTON, STAFFS. *Telephone: James Bridge 2692.*

M-W.61

"You know of course....

....that David Brown make a range of hobbing and shaving machines up to 18 feet gear diameter....turbine machines for high precision gearing.... 'Hydrax' machines for large scale production."

David Brown No. 10 Hydrax High Production Gear Hobbing Machine for gears up to 10 in. dia. and 4 D.P. This machine is designed for fully automatic working



"You don't know ?

Please allow us to send you our latest brochures."

DAVID BROWN

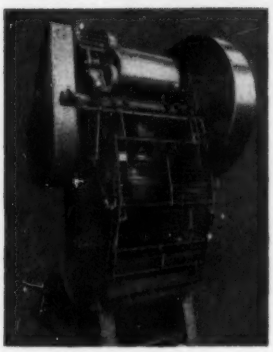
Almost a century of experience—99 years in fact

THE DAVID BROWN CORPORATION (SALES) LTD., MACHINE TOOLS DIVISION

BRITANNIA WORKS, SHERBORNE STREET, MANCHESTER, 3. TELEPHONE: BLACKFRIARS 4711

MOUNTAINEERS COURT DANGER

BUT PRESS OPERATORS NEED UDAL GUARDS



YOU CAN DEPEND ON UDAL

J. P. UDAL INTERLOCK WORKS, COURT RD., BIRMINGHAM 12 Phone : CALthorpe 311

---

the embodiment of this scientific age

Forward-looking engineers are embodying Heli-Coil Screw Thread Inserts in their designs because competition demands that they use only today's most advanced and successful techniques.

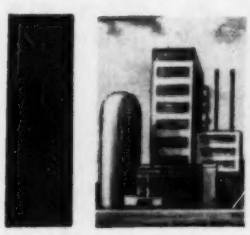
The Heli-Coil method of screw thread engineering can improve products in almost an infinity of ways. It can make dramatic cuts in time and labour costs.

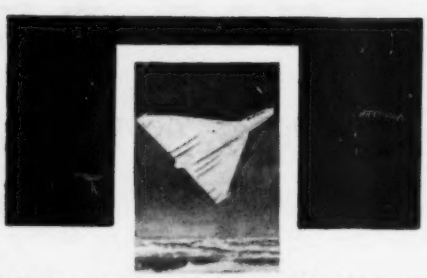
The Heli-Coil Insert is ideal for automation

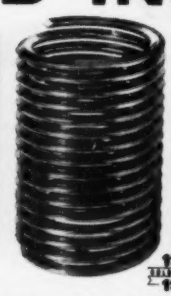
Why not have all the information in front of you — ask for — Sales Leaflet APL 48/E 2.

HELI-COIL*

SCREW THREAD INSERTS







Your newest design . . . is it quite up to date?

1909 1959

*HELI-COIL is a registered trade mark

Write for more data on HELI-COIL inserts to ARMSTRONG PATENTS CO. LTD. EASTGATE, BEVERLEY, YORKS.

Tel: Beverley 82212 (6 lines)

TWW—*an essential part of the industrial scene*

1. Dismantling
2. Structural Steelwork
3. Steel Stockholding
4. Cement
5. Iron & Steel Scrap
6. Wagon Building & Repairs
7. Machinery
8. Rails & Sidings
9. Contractors' Plant — Sale & Hire
10. Tractors
11. Road Surfacing Materials
12. Power Plant & Pumps
13. Industrial Plant

Other Ward activities include:-

Shipbreaking
Materials Handling Equipment
Factory Planning & Installation
Foundry Plant & Supplies
Insulating Materials
Food Preparing Machinery

THOS. W. WARD LTD

ALBION WORKS · SHEFFIELD

London Office:— Brettenham House, Lancaster Place, Strand W.C.2.

GP/80

FORD
USE
CLANCEY
CHILLED FACED CAST-IRON TAPPETS
SUPPLIED AS CASTINGS or FULLY MACHINED
G·CLANCEY LTD · BELLE VALE · HALESOWEN
THE LARGEST MANUFACTURERS OF VALVE GUIDES AND TAPPETS IN EUROPE
TELEPHONE: CRADLEY HEATH · 69411-2-3

HIGH DUTY CASTINGS
for the
ROVER 3 Litre
C. & B. SMITH LIMITED
Ironfounders · Wolverhampton
CBS

It's a more profitable move . . .

with DURALUMIN
REGD. TRADE MARK

and 'MG 5' *bodywork*
REGD. TRADE MARK

1

2

3

4

Bigger loads—lower running costs
Bigger profits !

1 'Duralumin' has been used for the entire cab, bodywork, sub-frame and flooring of this 25 cu yd capacity end-tipping vehicle. Specially built for John Hudson Ltd. for transporting coal in bulk, its durable bodywork must withstand arduous duties.
(Courtesy Duramin Engineering Co Ltd)

2 In this 'Duple' motor coach 'MG5' alloy is used in the form of durable, easily cleaned chequer-plate for flooring, steps and wheel arches. It resists the abrasive wear of scuffling feet, kicks and bumps, and a quick wash over keeps it bright and clean. *(Courtesy Duple Motor Bodies Ltd)*

3 Strong lightweight 'Duralumin' has been extensively used in the bodywork as well as for the entire flooring of this modern delivery van, made for Bentalls Ltd. of Kingston-upon-Thames. Unloaded weight is considerably reduced and as a result running costs will be lower.
(Courtesy Duramin Engineering Co Ltd)

4 This Leyland Octopus eight-wheeler is fitted with heavy-duty 'Duraplank' flooring manufactured from 'Duralumin'. This enables it to withstand abrasive, heavy wear and accept loads where weight is concentrated in small areas of the flooring.
(Courtesy Duramin Engineering Co Ltd)

Our Technical Sales Section will gladly help you to take full advantage of 'Duralumin', 'MG5' or any other James Booth light alloys, for modern motor vehicle bodywork

James Booth

James Booth & Company Limited, Argyle St. Works, Birmingham 7

Extrusions, large forgings, plate, sheet, strip, tubes and wire in brass and copper, as well as light alloys

DELTA GROUP
LONDON & BIRMINGHAM
TGA 187 156

HEY

GEAR TOOTH ROUNDING and CHAMFERING MACHINES

Automatic operation, High Production Rates on External and Internal Gears, Starter Rings, etc.

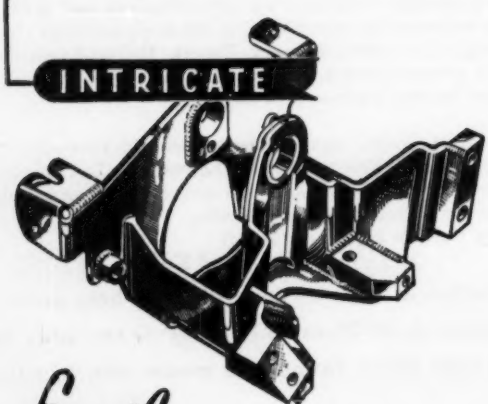
Used extensively by all leading gear specialists, automobile, aircraft, machine tool manufacturers, etc. Two models available for work up to 20in. and 10in. diameter. Illustrated data on request.

HEY ENGINEERING CO. LTD.
COVENTRY PHONE COVENTRY 88641

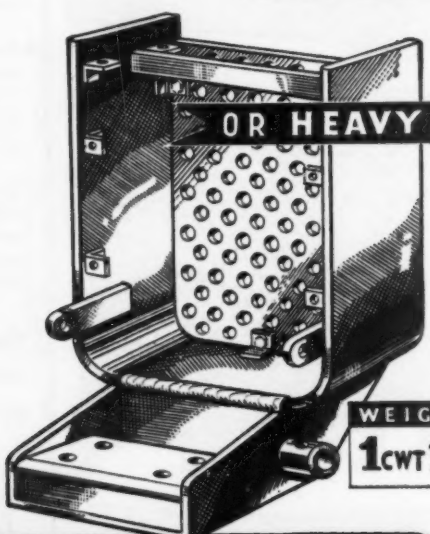
We also manufacture Rotary Cam and Profile Milling Machines, Short Thread Milling Machines, Multiple Drilling Heads and Machines, Tapping Machines, End Facing and Centring Machines, Special Machine Tools for High Production.

INKF 1957

SIMPLE INTRICATE



LIGHT OR HEAVY



WEIGHT 1CWT 1QR

Specify B.P *The Quality* PRESSINGS

Manufactured by

B. PRIEST & SONS LTD · OLD HILL · STAFFS · ENG.

Telephones: CRADLEY HEATH 66501/4

Telegrams: "BOLTS OLD HILL, CRADLEY HEATH"

For a wonderfully smooth drive...**Holroyd** Worm Gears

Did you know that all Holroyd worm gears are made in such a manner as to give some allowance for the inevitable deflection of bearings and gear housing? This results in an improvement in performance because the gears are then working correctly in the loaded position. We are able to do this by a technique of manufacture which gives precise control over the tooth marking.

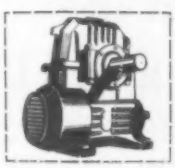
In certain cases we go further than this and make the gears so that they have some latitude in assembly without impairing the efficiency. This is particularly valuable where the gears are difficult of access for adjustment during assembly.

Another point—Holroyd worm gears are made, if required, right down to 1/1 ratio as an everyday product—we have a special plant for such gears.

And don't forget that Holroyd worm gears around 1/1 or 2/1 ratio will carry several times the load which can be put through a pair of straight faced spiral gears of the same dimensions, and will work with an efficiency of the order of 97 per cent.

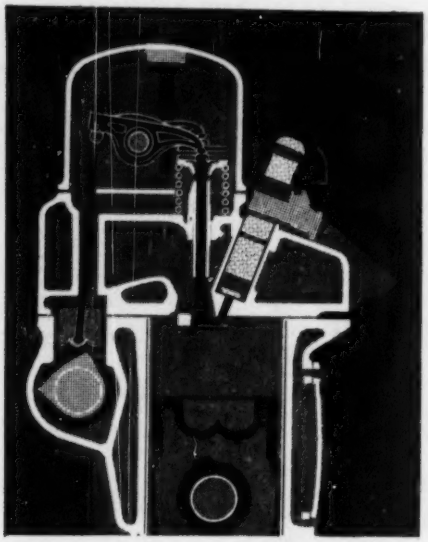
Have a word with **Holroyd**

John Holroyd & Co. Ltd., Milnrow, Lancashire



90 YEARS OF GEARS

CSC 191



NEW 13th EDITION NOW AVAILABLE

A standard work brought right up to date

by Donald H. Smith M.I.Mech.E.

Provides detailed information on the characteristics of high-speed diesel engines and their fuel injection equipment. The latest trends in fuel injection practice, combustion chamber design and fuel and lubricant developments are covered, engines for road, rail, marine and industrial uses are discussed and principal British, American and continental engines in current use are reviewed.

17s 6d net
by post 18s 8d

Over 96,000 copies sold

The Modern Diesel

from leading booksellers

Published by
ILIFFE & SONS LTD., DORSET HOUSE, STAMFORD ST., LONDON, S.E.1

'CORRUB'

CORK & RUBBER

A New Resilient Jointing Material for Exacting Applications

Coopers Corrub is a high-grade Cork and Synthetic Rubber composition. It is dimensionally stable and has a good solvent resistance.

Corrub combines the compressibility of Cork and the recovery properties of Rubber, without the "side-flow" of Plain Rubber. It has excellent resistance to fatigue and is therefore ideal for applications subject to frequent opening and resealing.

Corrub is available in various grades and thicknesses to SPEC. DTD762.

COOPERS MECHANICAL JOINTS LIMITED

LIVERPOOL ROAD, SLOUGH, BUCKS. Telephone 24511/5

COOPERS TECHNICAL ENGINEERS ARE AVAILABLE FOR CONSULTATION AT ALL TIMES

581

As a Plater you need this booklet

If you produce chromium plating you need to be aware of the Mond campaign to increase confidence in plating standards. It's described in detail in this illustrated booklet 'CONFIDENCE IN PLATING'. Here you'll see the press and TV advertising which will back this scheme in your interests. Right through the scheme runs the theme 'Chromium plating *can* be good!'

Your customers will want to know!

Do you supply the finished goods? Customers will be looking for the coloured labels of plating quality which are part of the Mond campaign.

Do you carry out plating for other people? Then show the special seal of plating standards on your estimates. For this entitles your customer to display the label.

Buyers of cars, household equipment, tools, furniture, and fittings of every type will be looking for plating they can be proud of. Make sure that *you*, as a plater, know all about this new campaign.

THE MOND NICKEL CO LTD

Thames House · Millbank · London · SWI

A new deal for Chromium Plate

FOR FURTHER INFORMATION ON THE LABELLING SCHEME COMPLETE AND RETURN THIS COUPON

Please send me your booklet 'CONFIDENCE IN PLATING' *with details of how I can join the scheme.*

NAME _____

ADDRESS _____

_____

COMPANY AND POSITION _____

_____

TGA P1

P. M. HELDT S.A.E.

explains principles and practice in the American automobile industry

The Automotive Chassis

Without Power Plant. 3rd Edition.
An authoritative exposition of American automobile practice. This valuable book deals comprehensively with all aspects of frames, springs, axles, wheels, tyres, drives, steering gear, brakes, universal joints and differential gears. 8½″×5″. 616 pp. 400 illustrations. 80s. net. By post 81s. 9d.

Torque Converters or Transmissions

5th Edition.
Describes the principles and operation of all modern American types of automobile clutches and gearboxes. Friction, automatic, hydraulic and electric clutches are dealt with, and the chapters on power transmissions include electric, hydrostatic, hydro-kinetic, automatic and pneumatic systems. 8½″×5″. 476 pp. 285 illustrations. 70s. net. By post 71s. 9d.

High-Speed Combustion Engines

16th Edition.
First published in 1912, this well-known standard textbook covers American practice in the most comprehensive manner. All aspects of the subject are covered in great detail, including the design, production and testing of all types of petrol engines. Profusely illustrated, this book is a complete treatise on current American practice. 8½″×5″. 776 pp. 521 illustrations. 105s. net. By post 106s. 9d.

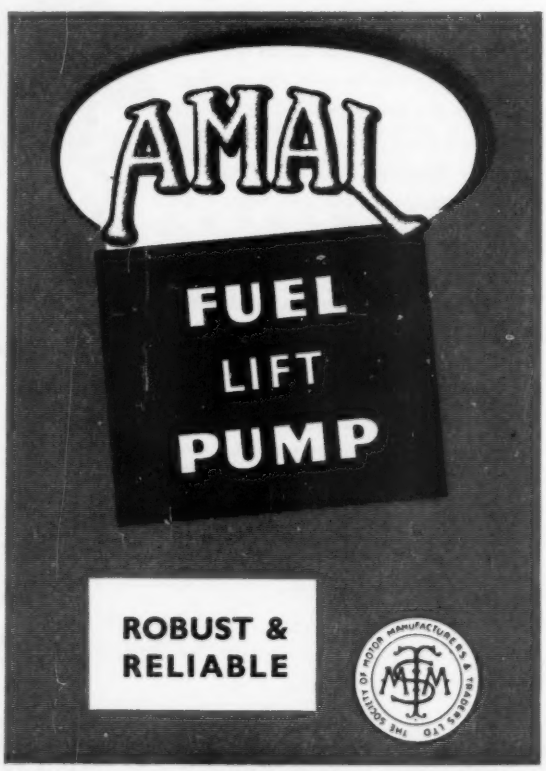
High-Speed Diesel Engines

7th Edition.
For Automotive, Marine, Railroad and Industrial Use. A guide to American practice in diesel engines of the automotive type. Design, fuels and fuel injection equipment, supercharging, lubrication, operation and maintenance are among the subjects dealt with, and there is also a chapter on gas turbines. 8½″×5″. 472 pp. 288 illustrations. 65s. net. By post 66s. 9d.

From leading booksellers. Published by:
ILIFFE AND SONS LIMITED - DORSET HOUSE - STAMFORD ST., LONDON, S.E.1

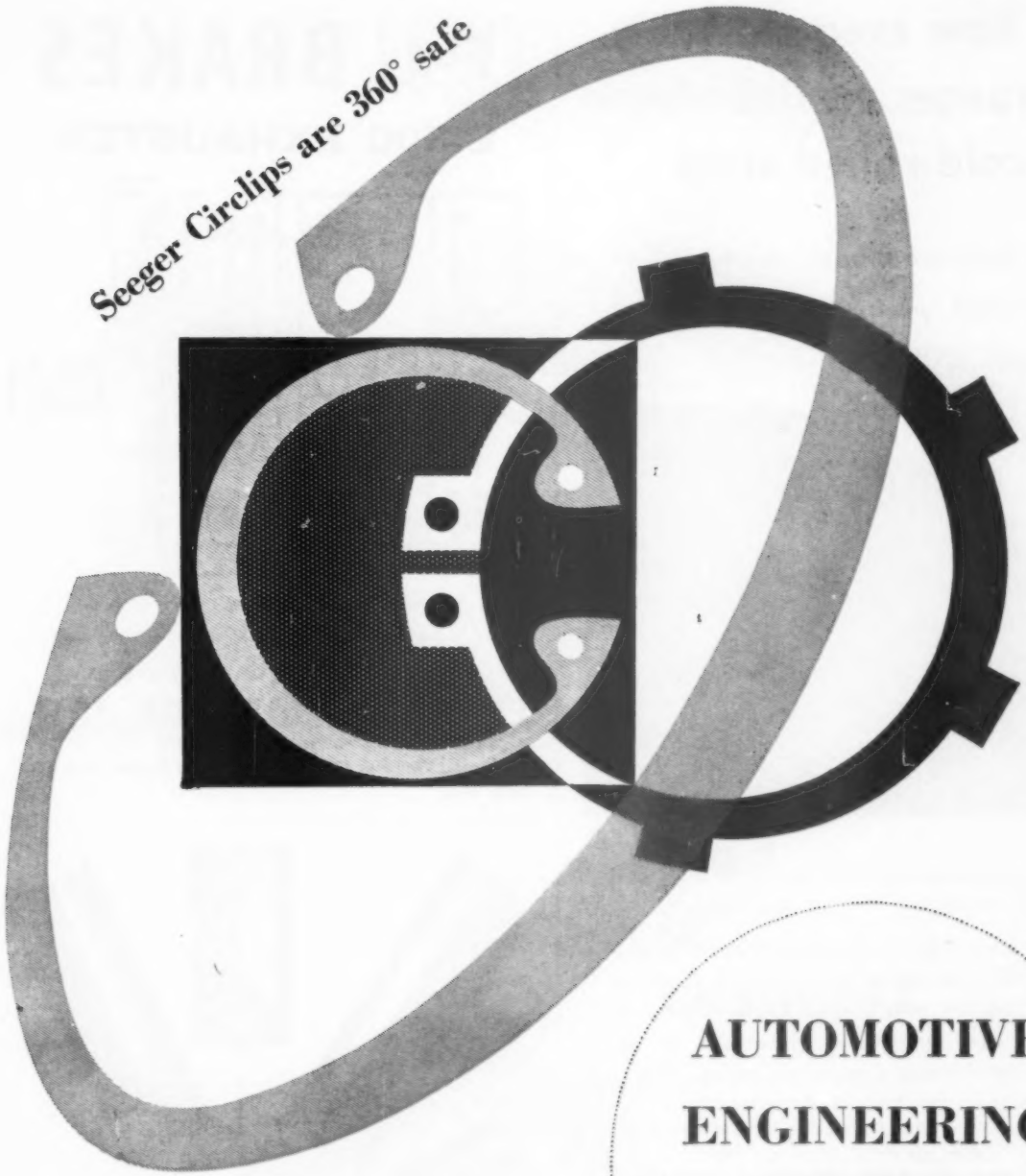
MITRE Precision Drop Forgings are preferred by leaders in the Automobile Industry.

A. J. VAUGHAN & CO. (MITRE WORKS) LTD.
Wolverhampton Road, WILLENHALL, Staffs. Phone: 486/7



AMAL LTD · HOLDFORD ROAD · BIRMINGHAM 6

A.206



AUTOMOTIVE ENGINEERING LIMITED

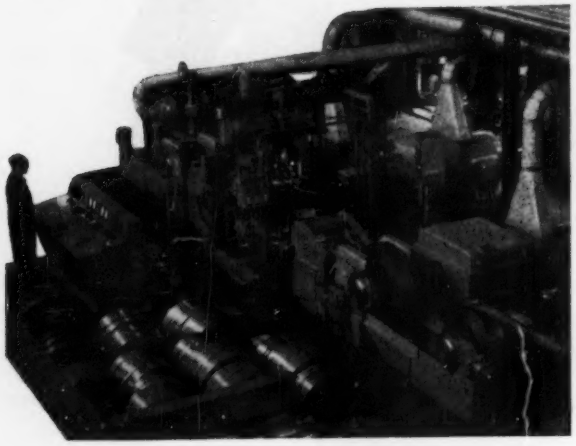
(One of the Sheepbridge Engineering Group)

On the Rolls-Royce approved list

The Green, Twickenham, Middlesex Telephone: POPesgrove 2206/9 Telegrams: Motif, Twickenham

Now even closer tolerances on Habershon cold-rolled strip

New, fully-automatic electronically controlled plant in operation at Holmes Mills



Now you can depend even more on the traditional 'quality in quantity' of Habershon steel strip.

Faster production: micro-measurements more consistent than ever before: tolerances even closer than those required by the strictest specification—all this is made possible at Habershons by the recent installation of completely automatic plant.

Progress is our greatest product

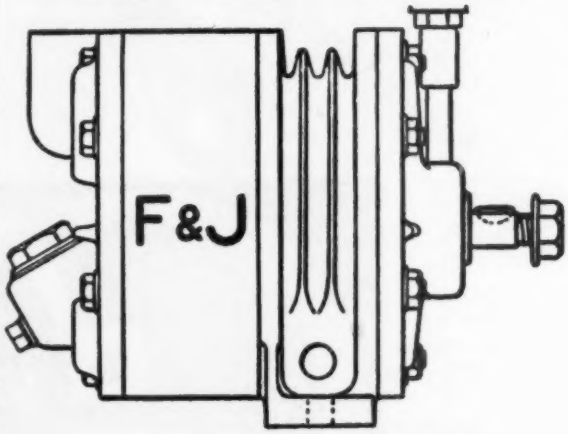
Habershon

STEEL STRIP AND SHEET

J. J. HABERSHON & SONS LIMITED, ROTHERHAM
Telephone : 2081 (6 lines)
LONDON : Enterprise Works, Angel Road, Edmonton, N.18
Telephone : Edmonton 5081
BIRMINGHAM : Daimler House, Paradise Street, Birmingham, 1
Telephone : Midland 1966

F&J BRAKES

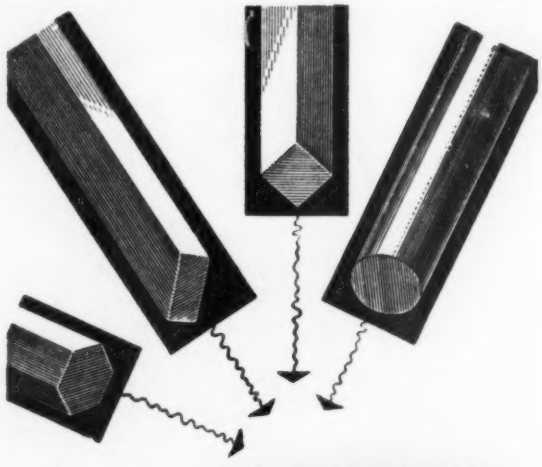
E.300 EXHAUSTER



● Very high efficiency ● self contained
300 cu. ft. per hour ● low price ● other sizes available.

Vacuum Servos for any Vehicle.

FEENY & JOHNSON LTD.
134/136 EALING ROAD, WEMBLEY, MIDDLESEX
Telephone: Wembley 4801/2 Telegrams: Feejohn, Wembley
DHB/7462A



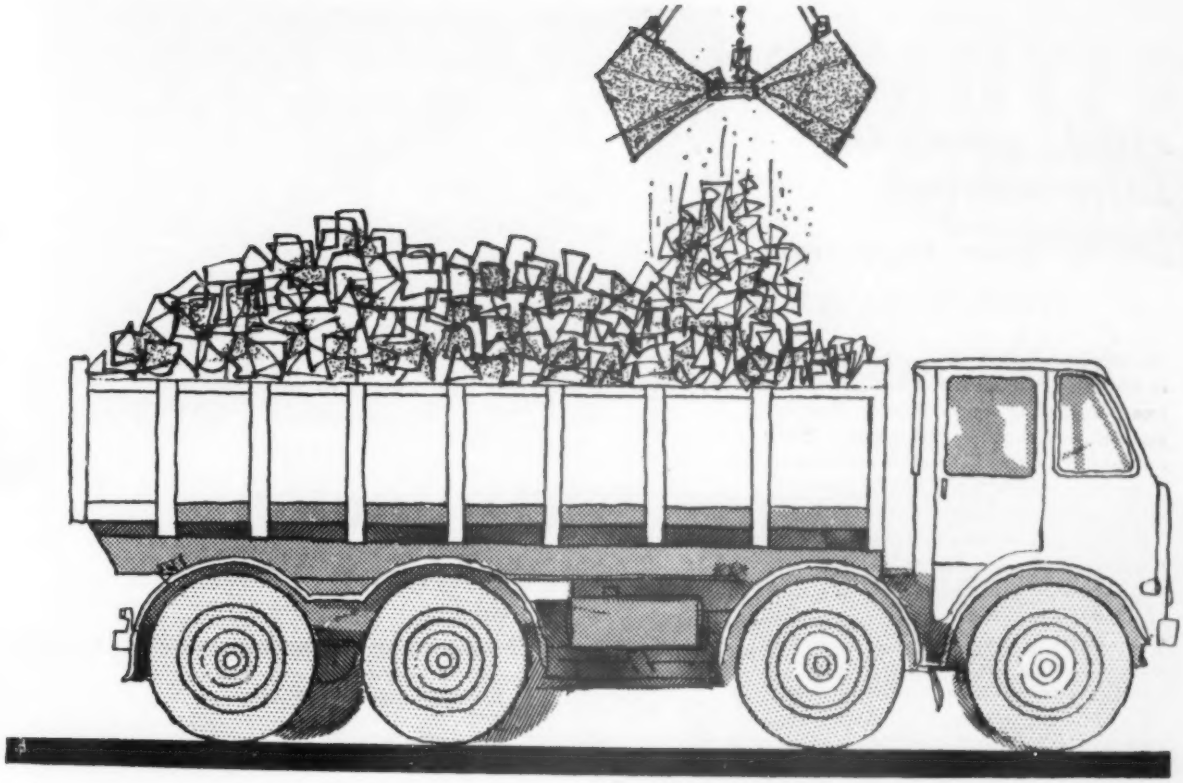
quality in special purpose steel

Dunelt

ALLOY AND SPECIAL CARBON STEELS

Black rolled, bright drawn or smooth ground, in heat-treated or unheated conditions. Free cutting steels, heat-resisting steels, die steels, shear blade steels, high-speed tool steels, stainless steels, valve steels, hollow steel bars.

DUNFORD & ELLIOTT (SHEFFIELD) LTD.
Attercliffe Wharf Works, Sheffield 9.
Telephone: 41121 (5 lines). *Telegrams:* "Blooms, Sheffield, 9".
London Office: Linford Street, S.W.8.
Birmingham Office: 25 Burlington Chambers, 118, New St., 2



a load of mischief?

Were it not for John Thompson pressings, many a truck would collapse like a heap of wet sand under misplaced and badly distributed loads. Stress and shock are specialised studies with us.

The overcoming of the various problems connected with them allows us, at design stage, to ensure a high strength-to-weight ratio in quantity produced pressings and fabrications.

JOHN THOMPSON

MOTOR PRESSINGS LTD.
WOLVERHAMPTON

JOHN THOMPSON MOTOR PRESSINGS LIMITED — JOHN THOMPSON GROUP

SCIENTIFIC PRESSINGS FOR ALL TRANSPORTATION INDUSTRIES

vital servicing information

. . . at your fingertips

The fifth volume in this widely-acclaimed series of books, specially prepared for the vehicle repair and servicing industry, includes 24 eight-page service data sheets covering most 1957 and 1958 cars, commercial vehicles and engines. These are supplemented by 28 comprehensive articles on the servicing of proprietary components, ranging from fuel pumps to automatic transmissions. All the sheets are fully illustrated with exploded drawings and photographs. The data sheets are arranged alphabetically under Cars; Commercial Vehicles and Diesel Engines; and Components. There is a glossary of technical terms and conversion and reference tables.

from leading booksellers.

SERVICING GUIDE to British Motor Vehicles

Vol. 5 covering 51 vehicles and components NOW AVAILABLE

67s. 6d. net. *BY POST* 70s. 312 *pp.*

Published for "Motor Trader" and "British Engineering and Transport"

TRADER PUBLISHING CO. DORSET HOUSE, STAMFORD STREET, LONDON S.E.1

Bushes and Bearings

ESCO T.C.C.

NEW CONTINUOUS CAST

Phosphor Bronze Rods

from ½" solid to 4" solid or cored

Also Centrifugal Cast and Chill Cast
Range of sizes from ½" solid to 11½" cored

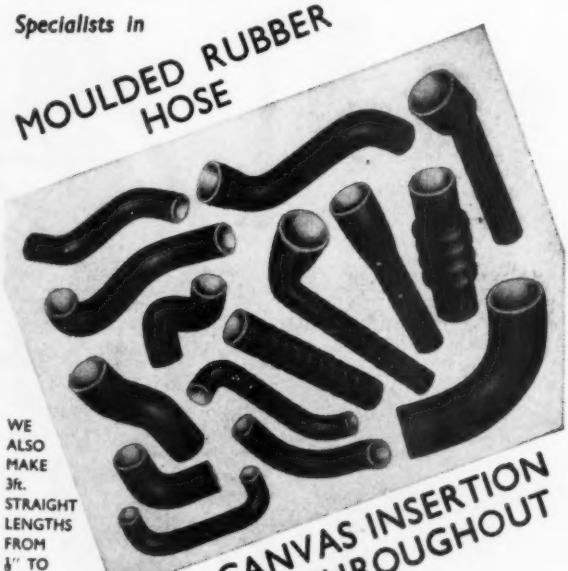
★ *100% fault free* ★ *Super finish and quality*
★ *Any length up to 6 ft.* ★ *Dimensional accuracy*

Send today for full details

THE **EYRE** SMELTING CO. LTD.
Also makers of TANDEM WHITE METALS & ESCO GUN METAL INGOTS, etc.
TANDEM WORKS MERTON ABBEY LONDON SW19 Tel: Mitcham 2031
ALUMINIUM WORKS WILLOW LANE MITCHAM SURREY Tel: Mitcham 2248

Specialists in

MOULDED RUBBER HOSE

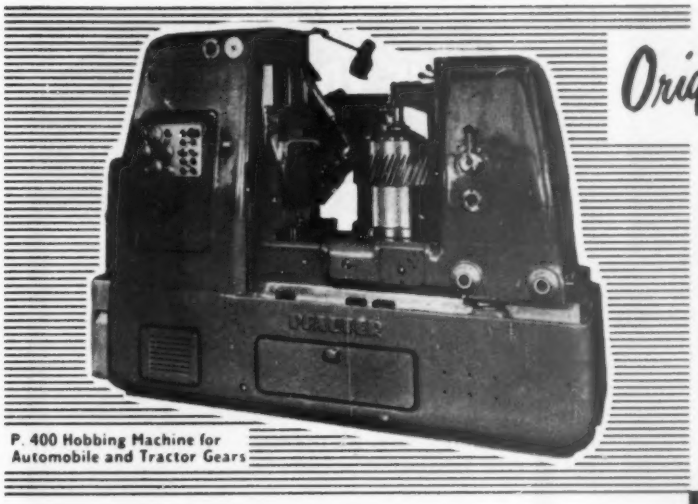


WE ALSO MAKE 3ft. STRAIGHT LENGTHS FROM ½" TO 3" BORE

With CANVAS INSERTION THROUGHOUT

CATALOGUE & PRICES ON APPLICATION

HERMETIC RUBBER CO. LTD.
HERMETIC WORKS · RYLAND ST · BIRMINGHAM 16
PHONE · EDGBASTON 0983/4 *Established 1895* GRAMS · HERMETIC, BIRMINGHAM



P. 400 Hobbing Machine for Automobile and Tractor Gears

Original PFAUTER Hobbers

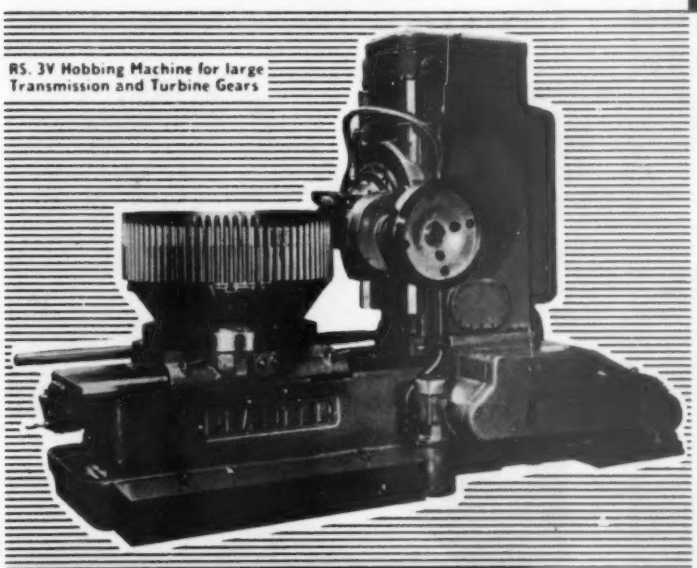
There's one to meet Your needs...

Pfauter Diagonal Hobbing, combined with Climb and Ultra-Speed Hobbing, gives faster production with greater accuracy, better surface finish and longer hob life.

WE WILL PROVE THIS TO YOU!

ORIGINAL PFAUTER

R. 16 Hobbing Machine for Instrument Gears (enlarged view of head)



RS. 3V Hobbing Machine for large Transmission and Turbine Gears

MANUFACTURING PROGRAMME

Vertical Work Mounting

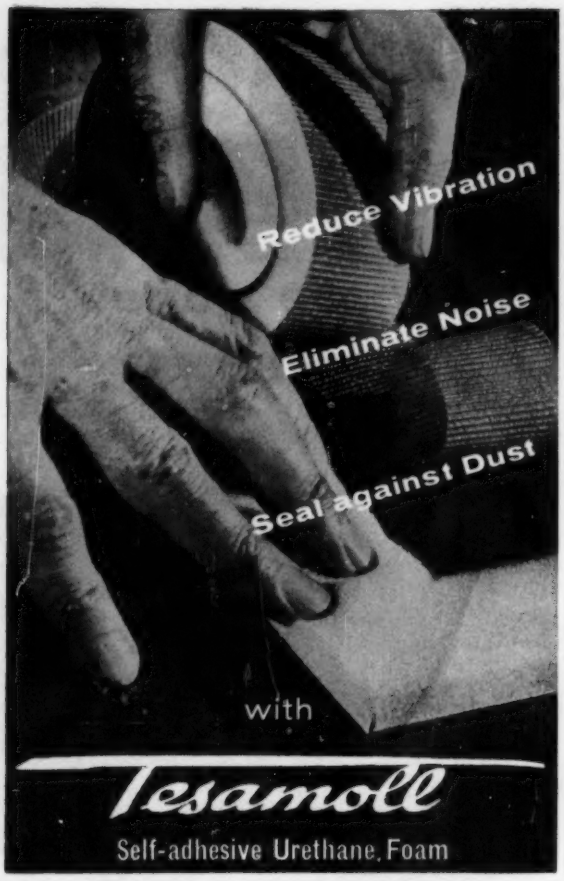
Model	Max. Gear dia. in.	Max. Gear width in.	Max. D.P.
R16	3	2¾	26
RS00	10/6	7	17/10
P250	10/8	6½	10/6
DRA duplex	10	8	3
P400	16	12	4
P500	20	15	3
RSIV	30	12½	3
P900	35	18	3
P1250	49	23	2
RS3V	72/47	25	2½/1¾
P1800	72	29½	1½
P2500	100	29½	1½
Horizontal Work Mounting			
P160	6½	15½	6
RS9K	11½	28½	2½
Worm and Thread Milling Machine			
SF1	11½	28¾	1½

VAUGHAN ASSOCIATES LIMITED

4 QUEEN STREET · CURZON STREET
LONDON, W.1. · Telephone: GROsvenor 8362-5

NRP 2270

Midland Office and Demonstration Dept: Trent Works, Wilford Crescent, Nottingham. Telephone: Nottingham 88008



REDUCE COSTS and SPEED PRODUCTION

Tesamoll is a new synthetic material with unique features. Its interconnected cellular construction compresses easily and has a constant, gentle push-back. It is rapidly replacing foam rubber and felt as well as giving results not always possible with traditional materials.

IN ELECTRONICS. Tesamoll has many uses in this modern sphere to mount instruments, cushion, pack, eliminate vibration and seal against dust.

ENGINEERING. Tesamoll can be used as gaskets for powder chambers, to seal against dust, to mount small components, to reduce chatter and vibration and noise.

RADIO AND TELEVISION. Tesamoll is invaluable because of its unique electrical, acoustical and dust sealing qualities. It is ideal for sealing T.V. tubes because it is electrostatically negative and tends to repel dust and other air or gas borne particles.

SAVE TIME. Tesamoll has a powerful pressure-sensitive adhesive which adheres firmly and instantly to any dry, clean surface. Self-adhesive Tesamoll saves many man-hours, is clean and quick to use and efficient in operation.

TESAMOLL. Can help you too. Tell us your problem, we may well have the answer. Please ask for samples for testing.

Send for Technical booklet

giving full details of the physical, acoustic, electrical and chemical characteristics together with the range of thicknesses, widths and prices from:

Tesamoll

SEALDRAUGHT LTD.,
Chandos House, Buckingham Gate,
London, S.W.1. Tel. ABBey 3571/2.

IF YOU WANT THE FINEST RADIATORS

Then go to the specialists — Marston Excelsior. Radiators, in light alloys and in copper, are just some of the many different components that Marston design and fabricate. The highest standards of design, based on years of specialist experience, are represented in all these Marston's products, which are renowned for their utmost efficiency and outstanding reliability. Marston radiators are in front of the finest.

MARSTON EXCELSIOR LTD
(A subsidiary company of Imperial Chemical Industries Ltd.)

ICI

WOLVERHAMPTON & LEEDS
Tel: Fordhouses 3361 or Leeds 637351

MAR.238

Cross-examine this British thread insert

Closely inspect the CROSS wire thread insert and satisfy yourself that it is a precision job. Made in high carbon steel, hardened and tempered, these inserts are simple, accurate, and effective. For ferrous applications they are available in stainless steel (not recommended for use with light metals), and in bronze for non-magnetic service Send for full particulars.

B.S.F., metric, B.S.P., B.A., Whitworth, Unified etc., etc.

CROSS MANUFACTURING CO. (1938) LTD.
BATH · SOMERSET.
Phone: COMBE DOWN 2355/8 Grams: 'CIRCLE' BATH

SALISBURY GEARS-

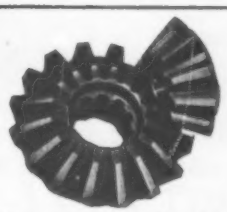
HYPOID AND SPIRAL BEVEL GEARS UP TO 24" dia.

High quality gears produced on the latest machines up to 24" dia. for all vehicles and locomotives.

Axle shafts of all types. Special induction hardening process cuts cost, saves weight, and permits higher loadings.

SALISBURY gears are smooth, silent and longer-lasting because of their exceptionally good finish—the result of the most recent manufacturing techniques and of constant attention to detail.

THERE ARE other benefits of this careful quantity-production on the most modern machines . . . excellent quality in every way . . . less servicing . . . a really competitive price . . . and, most important, *delivery on time!* That's why Salisbury gears are increasingly specified by designers and manufacturers . . . for cars such as Jaguar and Aston Martin, for the new diesel locomotives, for the tough work of building and agricultural machinery.



Revacycle and Coniflex low-cost gears, for car and light commercial differentials up to 4¼" pitch cone distance.

SALISBURY TRANSMISSION LTD

shares in the joint technical, research and productive resources of more than 20 famous firms, such as Laycock Engineering Ltd., Forgings and Presswork Ltd., Hardy Spicer Ltd., The Phosphor Bronze Co. Ltd., and others, who constitute the Birfield Group of Companies.

SALISBURY make most kinds of gears, axle shafts and transmissions for industry and commerce. And Salisbury technicians are always glad to co-operate on new projects and problems. Perhaps they can help you too? Please write for further details.

SALISBURY TRANSMISSION LTD

BIRCH ROAD · WITTON · BIRMINGHAM 6

Member of the Birfield Group

Whatever your transport query, the answer's as easy as—

ABC GOODS TRANSPORT GUIDE

Finger-tip facts on Home and Continental despatch problems–

With the ABC Goods Guide on your desk, it's no problem to find the nearest, quickest means of despatching *any* kind of goods—to anywhere in Europe. This indispensable reference covers all the very latest transport facilities. It lists long distance road transport operators (Independent and British Road Services), and gives full details of clearing houses, warehouses, air, canal, ferry and other specialized services. Order *your* copy of the latest edition *now*!

POST THIS ORDER TODAY!

JULY-DECEMBER 1959 ISSUE NOW AVAILABLE price 5s. 0d.

ILIFFE & SONS LTD., Dorset House, Stamford Street, London, S.E.1

Please enter my order for.....copies of the JULY-DECEMBER, 1959, and the JANUARY-JUNE, 1960, issues of the ABC GOODS TRANSPORT GUIDE (at 10s. per set) for which I enclose remittance of.....

NAME.....

ADDRESS.....

.....

.....

A FREE Folder you *Must* have!

Small diameter Plungers from ½ ton—4 tons pressure

Fast action

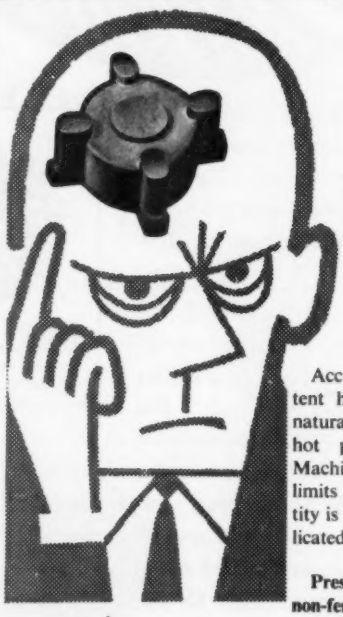
Remote control

If you are holding metal, wood, plastic materials, etc. in your manufacturing and assembly processes, you cannot afford not to have a copy of this folder showing many substantial time and money-saving applications.

Write for folder H/290

POWER JACKS LIMITED
VALETTA ROAD, ACTON, W.3.

Telephone: Shepherds Bush 3443/6 Telegrams: Newsorber, Ealux, London



Have you A PRESSING PROBLEM? . . .

Accuracy, good finish, consistent high quality — these come naturally with Sutcliffe Speakman hot pressings and stampings. Machining can be undertaken to limits down to .0005". No quantity is too large, no job too complicated, no standard too exacting.

Pressings and stampings in non-ferrous alloys including aluminium, brass, chromium-copper, cadmium-copper, manganese bronze and nickel silver. Castings in gun-metal, phosphor bronze and heat-resisting nickel chrome alloys.

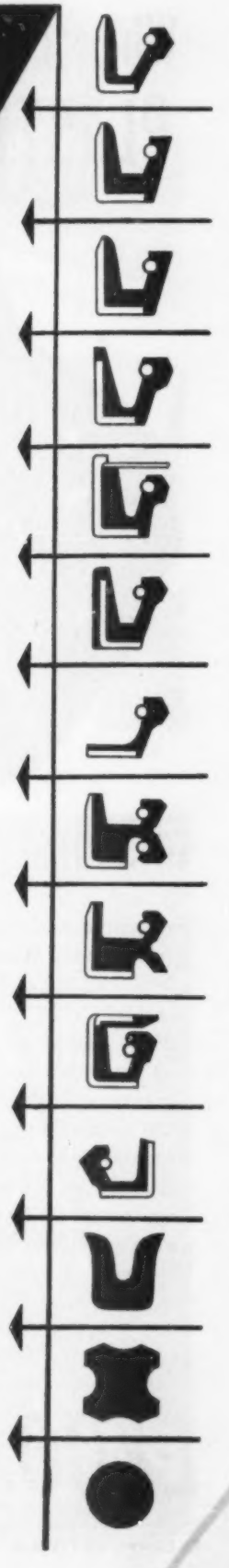
. . . ask

SUTCLIFFE SPEAKMAN

SUTCLIFFE SPEAKMAN & CO. LTD., Leigh, Lancashire. Tel: Leigh 94.
London Office: 2 Caxton St., Westminster, S.W.1. Tel: Abbey 3085.

DESIGNERS! THIS IS THE ONE REFERENCE BOOK TO SOLVE YOUR FLUID SEALING PROBLEMS — AND IT'S FREE!

When you design Fluid Seal applications, don't be without this valuable Reference Book issued by Pioneer. Prepared by practical engineers, it includes the latest up-to-date information on Fluid Seal Technology, comprehensive data on a wide variety of applications, how to install correctly with easy-to-follow illustrations for all the various types of seals produced by Pioneer, and a full range of available sizes. The Pioneer Reference Book which comes to you on request, is a practical work for the busy designer and is part of the Pioneer service which includes free advice on any Fluid Sealing problem.



Pioneer

OILSEALING & MOULDING CO. LTD

Factory and Head Office: Cottontree Works, Colne, Lancs. Tel: Wycoller 471 (8 lines)

GET YOUR COPY OF THE PIONEER FLUID SEAL CATALOGUE *NOW*

COMPANY NAME

ADDRESS

MARK FOR THE ATTENTION OF

When talking PLASTICS...

talk first to EKCO

A complex component of many separate mouldings? A single unit? Whether the job is simple or intricate EKCO PLASTICS always mould to the same high standard.

Many leading car makers value this. Rover use EKCO mouldings for the instrument panel and steering column of their new 3-litre. Hillman use EKCO mouldings for the steering column and warning-light panel of the latest Minx.

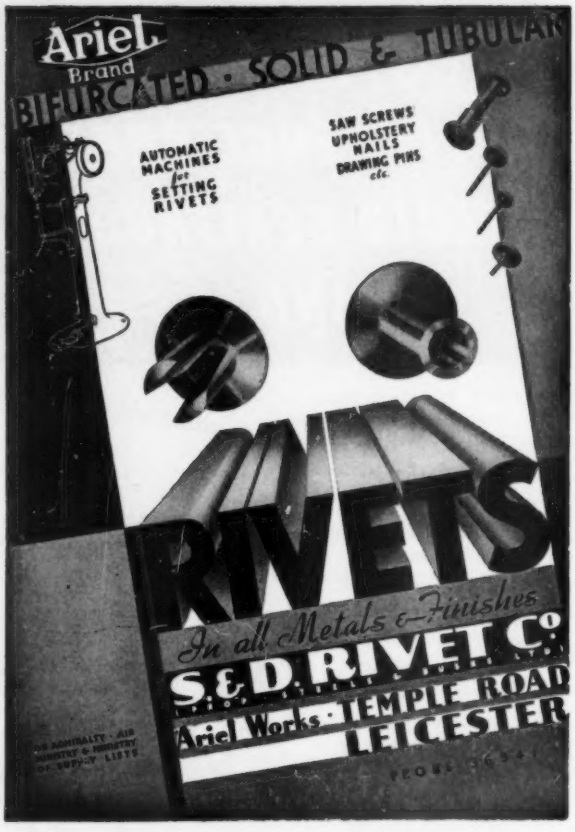
Here are just two important names who made sure of a first class job by talking plastics with EKCO. For, if it's a question of plastics mouldings, EKCO can do it—and do it that much better.

If you've a moulding problem, however complex, EKCO PLASTICS have the designers and engineers to help you solve it.

EKCO *PLASTICS* **for the motor industry**

EKCO PLASTICS LTD · SOUTHEND-ON-SEA · ESSEX

WPS-4460



There is nothing to equal the LEAD acid battery for reliability and economy

The technical officers of the Association are always glad to give individual assistance.

LEAD DEVELOPMENT ASSOCIATION, 18 Adam Street, London W.C.2
Telephone: WHitehall 4175. Telegrams: Leadevep, Rand, London

Air Pressure plus Toggle Action Combined

in the latest

Speetog REGD. TRADE MARK
AIR OPERATED CLAMP

(Patent Pending)

MADE IN TWO MODELS

...equipped with efficient

'Airtog' REGD. TRADE MARK
CUSHIONED CYLINDER

The mechanical advantages of the well-known "Speetog" Toggle Action now combined with the speed and efficiency of compressed air, allows for high speed operation with secure and finely controlled clamping pressures. Any number of these Clamps can be operated instantly at the touch of a switch.

Tracing Templates are available for the use of Drawing Offices.

Speed Tools Ltd

VEREKER HOUSE, GRESSE ST., LONDON W.1. Museum 1039/1099.

NRP

AUCTIONEERS & VALUERS OF
PLANT, MACHINERY AND FACTORIES

SINCE 1807

FULLER HORSEY
SONS & CASSELL

10, LLOYD'S AVENUE · LONDON · E.C.3. Phone ROYAL 4861

Rushbrooke

CLASSIFIED ADVERTISEMENTS

RATE 4d. per word, minimum 4/-. Each paragraph charged separately. Box number 5 words plus 1/-. Advertisements for the January 1960 issue should be to hand not later than first post 30th December. No responsibility accepted for errors.

BOOKS

I.A.E. Proceedings Vols. VI-XLI except XI and XV. I.Mech.E. (A.D.) Proceedings, 1947/8-1952/3 inclusive. I.Mech.E. Journals, June 1952-December 1953. Offers to Box No. 6220, c/o Automobile Engineer. [5710

● For automatic and capstan precision parts—in any metal—to your own specifications . . . *consult the specialist machinists.* I.F.V., D.A.I., D.I.Arm., A.R.B. Fully Approved.

PRECISION PARTS from the BAR by M C L

Telephone: Broadwell 1115 (4 lines) and 1757

M.C.L. & REPETITION LTD.

POOL LANE · LANGLEY · BIRMINGHAM

SITUATIONS VACANT

AUTOMOTIVE Development Engineer. A young and active Company with an expanding Research and Development Department wishes to engage a qualified Development Engineer. This appointment calls for a man of 25 to 30 years of age who has attained Higher National Certificate (Mechanical) and has sound practical experience on development work, preferably in the chassis component field. Applications should contain full details of experience, education and technical qualifications and current salary. Box No. 6218, c/o Automobile Engineer. [5708

DIESEL Development Engineer, aged 25 to 30 years, is required by an expanding organization in the automotive field. Qualifications for this appointment are minimum Higher National Certificate and experience in the combustion problems of high speed diesel engines. Details in application for this appointment should include previous experience, educational and technical background, and an indication of current salary. Box No. 6219, c/o Automobile Engineer. [5709

THE Rootes Group Truck Division requires Senior Chassis Designers and Draughtsmen. Applicants should be qualified to H.N.C. standard and experienced in modern commercial vehicle design and production methods. Excellent working conditions, with Pension Scheme. Apply in strict confidence, giving personal details, to the Secretarial Department, Commer Cars Ltd., Luton, Beds. [5707

PATENTS

THE Proprietor of British Patent No. 754947, entitled "A Device for Transporting Loads such as Automotive Vehicles or Freight", offers same for licence or otherwise to ensure practical working in Great Britain. Enquiries to Singer, Stern & Carlberg, 14 E. Jackson Blvd., Chicago 4, Illinois, U.S.A. [5711

For all types of **BOLTS, NUTS, SCREWS & STUDS...** CONTACT

Samuel Marsden & SON LTD
ALTRINCHAM ST., MANCHESTER 1.

LONDON W. Kelway-Bamber & Co. Ltd., Room 7, 70, Victoria Street, London, S.W.1. Tel: Abbey 6860. **N.E. COAST** Fasteners Ltd., 2, Hall Street, Barnard Castle, Co. Durham. Tel: Barnard Castle 3172.

dm SM 46

TUITION

A.M.I.M.I., City & Guilds, A.M.I.Mech.E., etc., on "No Pass-No Fee" terms. Over 95% successes. For details of Exams and Courses in all branches of Auto, Diesel, Aero, Mechanical Eng., etc., write for 148-page Handbook—Free. B.I.E.T. (Dept. 643), 29 Wright's Lane, London, W.8. [5672

FORD

have vacancies for

SPECIALIST ENGINEERS

✱ With practical experience in the application of INSTRUMENTATION, ELECTRONICS, RADIO OR TELEVISION.

✱ A specialist in STRESS and STRAIN ANALYSIS, PHOTO ELASTIC and STRESS LACQUER techniques would also be considered.

✱ Experience with vehicles, engines or aircraft desirable.

✱ Duties include : use, design and adaptation of instrumentation to product development problems.

✱ Applicants should be qualified to H.N.C. standard or have a Degree in Mechanical or Instrument Engineering, Electronics or Applied Physics.

Please write to C. T. PERRY, Training and Recruitment Department, Ford Motor Company Limited, Dagenham, Essex, quoting reference V.S.E.

FORD REQUIRE

AUTOMOBILE DEVELOPMENT ENGINEERS

Applicants must have practical experience of Motor Vehicles in industry, or in the field, and a basic sound knowledge of Automobile Engineering.

Personal qualities must include initiative, adaptability and self-reliance.

Minimum qualification H.N.C or a Degree in Automobile or Mechanical Engineering.

Please write to C. T. PERRY, Training and Recruitment Department, Ford Motor Company Limited, Dagenham, Essex, quoting reference V.A.D.

COTTON BAGS

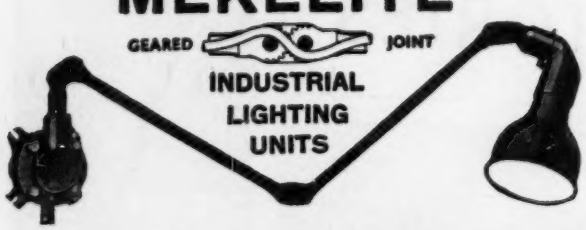
FOR SPARE PARTS, Etc.

Walter H. Feltham & Son Ltd

Imperial Works, Tower Bridge Road
Telephone: HOP 1784 LONDON, S.E.1

MEKELITE

GEARED JOINT



INDUSTRIAL LIGHTING UNITS

For wall, bench or machine mounting *Catalogue sent free on request.*

MEK-ELEK Engineering Ltd. MITcham 3072

17 Western Road MITCHAM Surrey

THE VILLIERS ENGINEERING COMPANY LTD.

MARSTON ROAD, WOLVERHAMPTON.

Applications are invited from suitably qualified engineers for positions of Design Draughtsmen in connection with the development of high speed industrial diesel engines. Appointments will be of Senior Executive level and will carry salaries commensurate with the responsibility.

All applications in writing, to the Personnel Manager, giving full details of qualifications and experience, also quoting present salary.

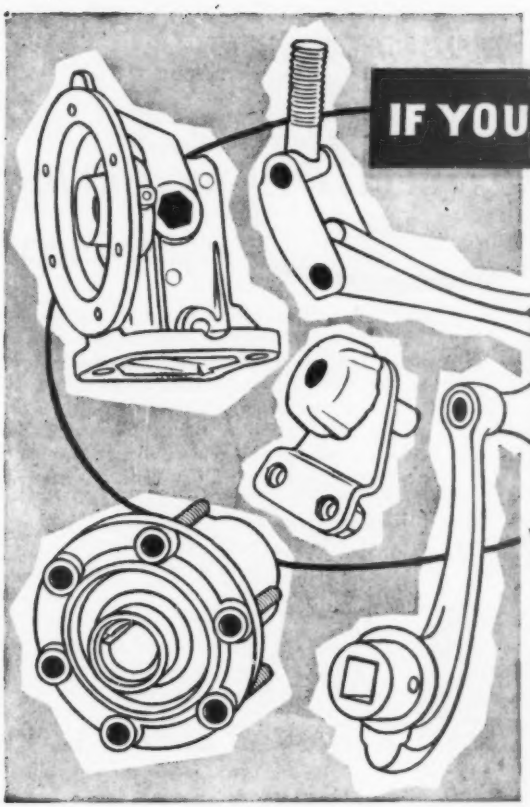
SHEET METAL MACHINERY, MACHINE TOOLS, PRESSES, PLASTICS & WOODWORKING MACHINES

New and used — many of each EX STOCK — for cash or monthly account, hire purchase or by the F J E Machine Hire Plan.
May we tell you more ?

F.J.Edwards Ltd

EDWARDS HOUSE
359-361 EUSTON RD., LONDON, N.W.1
Phones: EUSton 4681 & 3771

and Lansdowne House
41 Water St., Birmingham 3
CENtral 7606-8



IF YOU MAKE THESE

Do you make automobile components, accessories, electrical equipment? If they require rivetting you need T.T. Rivet Spinners. Not only are they faster and cheaper to operate, they enhance the final appearance and form a perfect head without swelling the rivet shank. Coping with mild steel rivets up to ¾ in. diam. the range includes vertical single spindle machines suitable for most purposes, and horizontal duplex models for heading both ends in one operation. Your samples completed for approval.

YOU NEED THIS

RS5VMD $\frac{5}{16}$ in. cap. foot operated model.

TURNER
MACHINE TOOLS LTD
63-68 · PRINCIP ST · BIRMINGHAM 4

Telephone: ASTon Cross 2244

DG

YOUR NEW DESIGN

Talk to **Delaney Gallay** about the Heater

We have a very great deal of experience in the design and development of car heating, demisting and air conditioning equipment, together with extensive production capacity.

Whilst you are still in the design stage, why not have a chat with us? We will be glad to design and produce something to suit your requirements.

We are also specialists in radiators, tanks and presswork.

Vulcan Works, Edgware Rd, London, N.W.2.
Telephone: GLAdstone 2201.

Delaney Gallay LTD

Marconi *radar gear accuracy*

checked with Goulder *measuring equipment*

Checking high accuracy radar gears on a Goulder No. 1 Rolling Gear Tester at Marconi's Wireless Telegraph Co. Ltd., Chelmsford.

To ensure the utmost precision—so vital in radar gears—Marconi's Wireless Telegraph Co. Ltd. rely on simple but exact checks with Goulder equipment. Designed with the greatest attention to detail and made from specially selected materials, Goulder equipment embodies the highest standards of accuracy and craftsmanship. The comprehensive range of Goulder gear measuring instruments includes five types of rolling gear testers, as well as involute testers and lead measuring machines. Special machines can also be made for particular requirements.

Goulders also make

Worm and wheel testers · Hob tester
Pitch testers · Sine tables
Universal beam calipers · Jigs, fixtures
Tools and gauges · Aircraft components

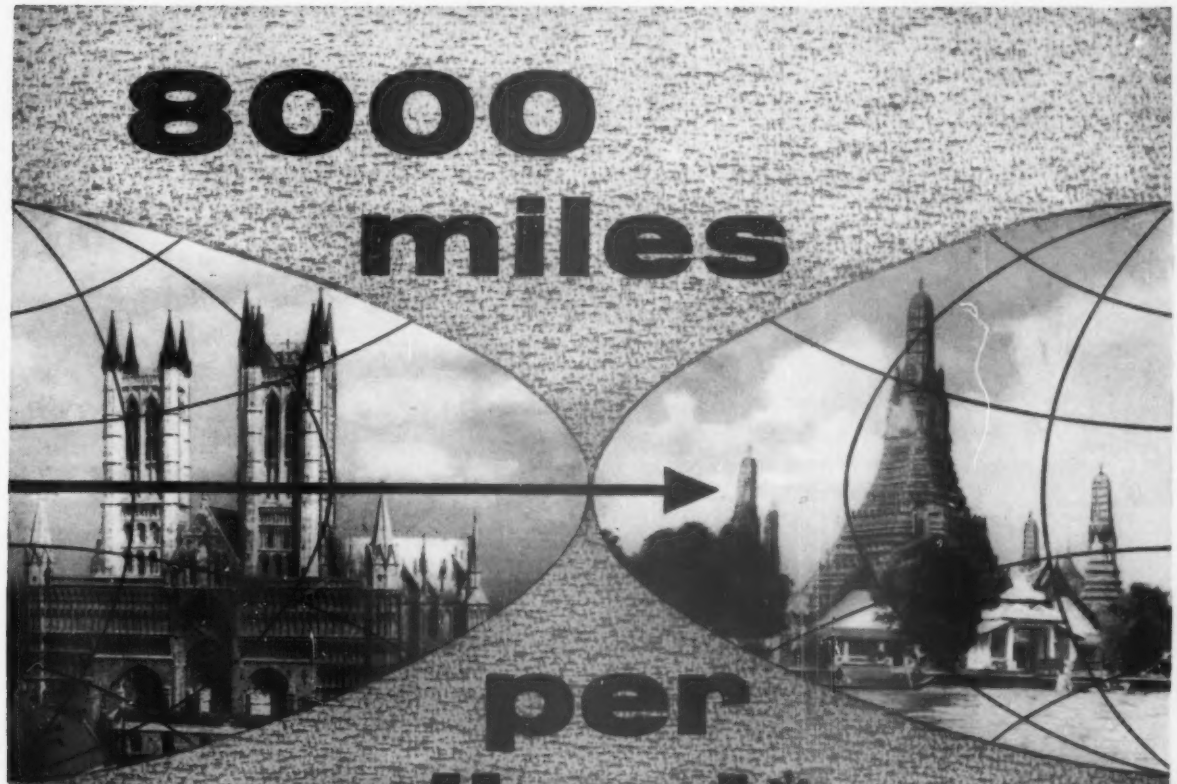
We shall be pleased to advise on the best method of gear measurement for your needs—just telephone or write to:

J. Goulder & Sons Ltd.
Kirkheaton, Huddersfield.
Telephone: Huddersfield 5252-3

INDEX TO ADVERTISEMENTS

	PAGE
Adamant Engineering Co. Ltd.	27
Aircraft-Marine Products (Gt. Britain) Ltd.	32
Aluminium Bronze Co. Ltd.	78
Amal Ltd.	94
Archdale, James, & Co. Ltd.	21
Armstrong Patents Ltd.	86
Armstrong Whitworth & Co. (Pneumatic Tools) Ltd.	39
Atlas Copco AB	Cover ii
Automotive Engineering Ltd.	95
Automotive Products Co. Ltd.	7, 8
B.I.P. Chemicals Ltd.	43
Birmabright Ltd.	14
Borg & Beck Co.	6
Booth, Jas., & Co. Ltd.	89
Bound Brook Bearings Ltd.	81
Bowaters Sales Co. Ltd.	77
British Oxygen Co. Ltd., The	26
British Piston Ring Co. Ltd., The	61
British Timken: Division of The Timken Roller Bearing Company	Cover i
Brook Motors Ltd.	68
Broom & Wade Ltd.	22
Brown, David, Corporation (Sales) Ltd., The	2, 3, 35, 85
Bull, John, Rubber Co. Ltd.	82
Bury Felt Mfg. Co. Ltd.	45
Cape Asbestos Co. Ltd., The	28, 29
Cashmore, John, Ltd.	Cover iv
C.A.V. Ltd.	16
CIBA (A.R.L.) Ltd.	34
Clancey, G., Ltd.	88
Clayton Dewandre Co. Ltd.	Cover iii
Clayton Wright, Howard, Ltd.	37
Coopers Mechanical Joints Ltd.	92
Copper & Asbestos Washer Co. Ltd.	80
Cross Mfg. Co. (1938) Ltd.	100
Dartmouth Auto Castings Ltd.	62
Delaney Gallay Ltd	107
Deloro Stellite Ltd.	82
Desoutter Bros. Ltd.	48
Dowty Seals Ltd.	50
Drummond - Asquith (Sales) Ltd.	11
Dunford & Elliott (Sheffield) Ltd.	96
Du Pont Co. (United Kingdom) Ltd.	38
Dupree Swift & Co Ltd.	78
Edwards, F. J., Ltd.	106
Ekco Plastics Ltd.	104
Electrical Development Association	47
Electro Chemical Eng. Co. Ltd.	83
E.M.I. Electronics Ltd.	69
Eyre Smelting Co. Ltd., The	98
Farnborough Engineering Co. Ltd.	58
Feeny & Johnson Ltd.	96
Feltham, Walter H., & Sons Ltd.	106
Fenner, J. H., & Co. Ltd.	12
Ferodo Ltd.	41
Firth-Derihon Stampings Ltd., The	75
Firth, Thos., & John Brown Ltd.	54
Fletcher Miller Ltd.	80
Ford Motor Co. Ltd.	31, 106
Fry's Metal Foundries Ltd.	72
Fuller, Horsey, Sons & Cassell	105
General Electric Co. Ltd., The	84
Goulder, J., & Sons Ltd.	108
Habershon, J. J., & Sons Ltd.	96
Hardy Spicer Ltd.	73
Harris, John, Tools Ltd.	52
Hepworth & Grandage Ltd.	23
Herbert, Alfred, Ltd.	1
Hermetic Rubber Co. Ltd.	98
Hey Engineering Co. Ltd.	90
High Duty Alloys Co. Ltd.	19
Hoffmann Manufacturing Co. Ltd., The	65
Holroyd, John, & Co. Ltd.	91
Holset Eng. Co. Ltd.	25
I.C.I. (Heat Treatment) Ltd.	13
I.C.I. (Marston Excelsior) Ltd.	100
Ilford Ltd.	53
Iliffe & Sons Ltd.	92, 94, 102
International Twist Drill Co. Ltd., The	66
Jackson, H., Ltd.	57
Kirkstall Forge Eng. Ltd.	24
Lapointe Machine Tool Co. Ltd., The	74
Lead Development Association	104
Ley's Malleable Castings Ltd.	49
Lockheed Hydraulic Brake Co. Ltd.	5
Marsden, Samuel, & Son Ltd.	106
M.C.L. & Repetition Ltd.	106
Mek-Elek Engineering Ltd.	106
Metalastik Ltd.	51
Metropolitan-Vickers Electrical Co. Ltd.	55
Midland Motor Cylinder Co. Ltd., The	59
Mills, Wm., Ltd.	76
Mond Nickel Co. Ltd.	93
Newall, A. P., & Co. Ltd.	4
Pioneer Oilsealing & Moulding Co. Ltd.	103
Power Jacks Ltd.	102
Priest, B., & Sons Ltd.	90
Ransome & Marles Bearing Co. Ltd.	30
Renold Chains Ltd.	71
S. & D. Rivet Co.	104
Salisbury Transmission Co. Ltd.	101
Salter, Geo., & Co. Ltd.	60
Saunders-Roe	36
Schrader's, A., Son	40
Sealdraught Ltd.	100
Servicing Guide to British Vehicles	98
Sheffield Twist Drill & Steel Co. Ltd., The	17
Shell-Mex & B.P. Ltd.	46, 67
Shotton Bros. Ltd.	20
Silentbloc Ltd.	15
Simms Motor Units Ltd.	42
Skefko Ball Bearing Co. Ltd.	64
Smith, C. & B., Ltd.	88
Speed Tools Co. Ltd.	105
Steel Co. of Wales Ltd., The	56
Sutcliffe Speakman & Co. Ltd.	102
Tecalemit Ltd.	33
Terry, Herbert, & Sons Ltd.	9
Thompson, John, Motor Pressings Ltd.	97
Turner Bros. Asbestos Co. Ltd.	79
Turner Machine Tools Ltd.	107
Udal, J. P., Ltd.	86
Vaughan, A. J., & Co. (Mitre Works) Ltd.	94
Vaughan Associates Ltd.	99
Ward, Thos. W., Ltd.	87
Wellworthy Piston Rings Ltd.	70
Weston, Chas., & Co. Ltd.	18
West Yorkshire Foundries Ltd.	44
Wild-Barfield Electric Furnaces Ltd.	10
Wiley, Jas., & Son Ltd.	84

Printed in Great Britain for the Publishers, ILIFFE & SONS LTD., Dorset House, Stamford Street, London, S.E.1, by James Cond Ltd., Charlotte Street, Birmingham 3. "Automobile Engineer" can be obtained abroad from the following: AUSTRALIA & NEW ZEALAND: Gordon & Gotch Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service Ltd.; Gordon & Gotch Ltd. SOUTH AFRICA: Central News Agency Ltd.; Wm. Dawson & Sons (S.A.) Ltd. UNITED STATES: Eastern News Co. Entered as Second Class Matter at the New York, U.S.A., Post Office.



Yet these low-consumption 'CD' lubricators give an adequate and constant oil supply to every chassis bearing

And this supply through individual pressure feed lines extends the life of each bearing by up to ten times. This saving is reinforced by reduced labour costs and cuts in wastage and time. Thousands of discriminating operators attest to the worth of these ingenious machines which are available for feeding from 24 to 72 points. Distributors in your area are available for installations. Specify for your new vehicles. Please write for further details.

* average consumption for single-headed 24 or 36 point Clayton Dewandre Multipoint chassis lubricators.

Clayton Dewandre Automatic Chassis Lubricators

CLAYTON DEWANDRE CO. LTD., TITANIC WORKS, LINCOLN, ENGLAND. TELS: LINCOLN 23272

L.26

"... but STAINLESS STEEL CHEAPER this way!"

"Cashmores hold the stocks and carry the financial burden—whilst I use valuable floor space for production. And, what's more, there's no need for me to worry about losses on redundant stock.

"With their new TELEX service and speedy delivery fleet you can say Cashmore's stocks are my stocks—and that's why it's cheaper all round!"

A call to CASHMORES brings STAINLESS to your doorstep—in bars, flats, hexagons, sheets or plate, to specifications in general use.

CASHMORES

JOHN CASHMORE LIMITED

GREAT BRIDGE · TIPTON · [illegible]

Telephone: TIPton 2181/7 Telex: [illegible]

London Office: Artillery Mansions, 75 Victoria Street, London, S.W.1. Telephone: [illegible]

SM/JC.4247/55